DEVELOPMENT, GROWTH, AND STATE OF THE ATOMIC ENERGY INDUSTRY

HEARINGS

BEFORE THE

JOINT COMMITTEE ON ATOMIC ENERGY

CONGRESS OF THE UNITED STATES

EIGHTY-FIFTH CONGRESS

SECOND SESSION

ON

DEVELOPMENT, GROWTH, AND STATE OF THE ATOMIC ENERGY INDUSTRY

1958

Pursuant to Section 202 of the Atomic Energy Act of 1954

FEBRUARY 19, 20, 21, 26, 28; MARCH 3 AND 4, 1958

Printed for the use of the Joint Committee on Atomic Energy

UNITED STATES
GOVERNMENT PRINTING OFFICE
24041 WASHINGTON : 1958

JOINT COMMITTEE ON ATOMIC ENERGY

CARL T. DURHAM, North Carolina, *Chairman*

CLINTON P. ANDERSON, New Mexico, *Vice Chairman*

CHET HOLIFIELD, California	RICHARD B. RUSSELL, Georgia
MELVIN PRICE, Illinois	JOHN O. PASTORE, Rhode Island
PAUL J. KILDAY, Texas	ALBERT GORE, Tennessee
JOHN J. DEMPSEY, New Mexico	HENRY M. JACKSON, Washington
JAMES E. VAN ZANDT, Pennsylvania	BOURKE B. HICKENLOOPER, Iowa
JAMES T. PATTERSON, Connecticut	WILLIAM F. KNOWLAND, California
THOMAS A. JENKINS, Ohio	JOHN W. BRICKER, Ohio
CRAIG HOSMER, California	HENRY DWORSHAK, Idaho

JAMES T. RAMEY, *Executive Director*

DAVID R. TOLL, *Staff Counsel*

DEPOSITED BY THE
UNITED STATES OF AMERICA

STATEMENT

This publication constitutes the major portion of the 1958 hearings held annually by the Joint Committee on "development, growth, and state of the atomic energy industry," pursuant to section 202 of the Atomic Energy Act of 1954.

For the convenience of the public, a portion of the testimony of February 19, 1958, and all of the testimony of February 24 and 25, 1958, concerning problems of the uranium mining and milling industries, has been printed in a separate publication entitled "Problems of the Uranium Mining and Milling Industry."

CONTENTS

(A brief subject index will be found on p. 625)

	Page
Hearing dates:	
Wednesday, February 19, 1958	1
Thursday, February 20, 1958	75
Friday, February 21, 1958	181
Wednesday, February 26, 1958	245
Friday, February 28, 1958	277
Monday, March 3, 1958	343
Tuesday, March 4, 1958	429
Statement of:	
Biemiller, Andrew J., director, Department of Legislation, AFL–CIO	299
Busby, Jack K., president, Pennsylvania Power & Light Co	277
Clapp, W. J., president, Florida Power Group	395
Cohen, Howard H., secretary and counsel, Sylvania-Corning Nuclear Corp	274
Davenport, Lee L., president, Sylvania-Corning Nuclear Corp	270
de Hoffman, Frederic, vice president, General Dynamics Corp	351
Diamond, Edward, Acting General Counsel, Atomic Energy Commission	4, 75
Ellis, Clyde, executive manager, National Rural Electric Cooperative Association	310
Fairman, James F., senior vice president, Consolidated Edison Company of New York, Inc	460
Fields, K. E., General Manager, Atomic Energy Commission	4, 75
Floberg, John F., Commissioner, Atomic Energy Commission	4, 75
Gardner, Edward R., Director, Office of Special Projects, Atomic Energy Commission	75
Gilbert, Robert A., Intercontinental Research & Analysis Co	484
Goodman, Clark, Division of Reactor Development, Atomic Energy Commission	75
Goodman, Leo, Atomic Energy Adviser, UAW	510
Graham, John S., Commissioner, Atomic Energy Commission	4, 75
Grahl, James L., director, Atomic Energy Service, American Public Power Association	224
Gravgaard, O. N., president, Rural Cooperative Power Association	343
Hallock, H. R., Texas Atomic Research Foundation	345
Hill, Hibbert, chief engineer, Northern States Power Co	325
Johnson, Jesse C., Director, Division of Raw Materials, Atomic Energy Commission	4
Johnson, Thomas H., vice president and general manager of research, Raytheon Manufacturing Co	491
Johnson, W. E., project manager, atomic power department, Westinghouse Electric Corp	277
Keen, John W., manager, Wolverine Electric Cooperative	328
Kimball, Dan A., president, Aerojet General Corp	293
Leggett, W. D., Jr., vice president, engineering services, Alco Products, Inc	252
Libby, Dr. Willard F., Commissioner, Atomic Energy Commission	51, 75
Lindseth, Elmer L., president, Cleveland Electric Illuminating Co., and chairman, Edison Electric Institute committee on atomic power	371
Linsenmeyer, John C., executive vice president, American Radiator & Sanitary Corp	208
Luntz, Jerome D., editor, Nucleonics magazine, accompanied by John E. Kenton	149
Marshall, Charles L., Director, Division of Classification, Atomic Energy Commission	4
McCullough, C. Rogers, Chairman, Advisory Committee on Reactor Safeguards	110

Statement of—Continued Page
McCune, Francis K., vice president, General Electric Co 429
McDaniel, Dr. Paul W., Acting Director, Division of Research, Atomic Energy Commission 4
McDonald, Angus, coordinator, division of legislative services, National Farmers Union 237
Menke, John, president, Nuclear Development Corporation of America 450
Michaelis, Michael, senior atomic energy adviser of Arthur D. Little, Inc 126
Nagey, Tibor F., general manager, nuclear division, the Martin Co 218
Nelson, Curtis A., Director, Division of Inspection, Atomic Energy Commission 75
Parsegian, V. L., dean, School of Engineering, Rensselaer Polytechnic Institute 138
Pittman, Frank, Director, Office of Industrial Development, Atomic Energy Commission 4
Powers, Philip N., president, Internuclear Co 172
Price, Harold L., Director, Division of Licensing and Regulation, Atomic Energy Commission 75
Salisbury, Morse, Director, Division of Information Services, Atomic Energy Commission 4
Shapiro, Zalman M., president, Nuclear Materials & Equipment Corp 260
Sigal, Benjamin C., general counsel, International Union of Electrical, Radio & Machine Workers, AFL–CIO 410
Sloan, David B., president, Gibbs & Hill, Inc 334
Smith, Oscar S., Director, Division of Organization and Personnel, Atomic Energy Commission 4
Spector, Norman A., vice president, Vitro Corporation of America 496
Sporn, Philip, president, American Gas & Electric Co. and American Gas & Electric Service Corp 389
Starr, Dr. Chauncey, vice president, Atomics International 181
Steiger, William A., vice chairman, the Committee on Patents of the National Association of Manufacturers 421
Stratton, Reuel C., vice chairman, Advisory Committee on Reactor Safeguards 110
Strauss, Lewis L., Chairman, Atomic Energy Commission 4, 75
Thomas, J. B., Texas Atomic Research Foundation 345
Townsend, Oliver, assistant manager, Atomic Industrial Forum 101
Vance, Harold S., Commissioner, Atomic Energy Commission 61, 75
Welsh, J. Robert, president, Southwest Atomic Energy Associates 245
Wolman, Dr. Abel, Advisory Committee on Reactor Safeguards 110
Zinn, Walter H., president, General Nuclear Engineering Corp 397
Statements and letters supplied for the record:
AEC, civilian power reactor program, contracting policies 577
AEC, correspondence concerning Commission comments on views of industry 579
AEC summary of status of power reactor program in early 1958 569
AEC, updating cost and schedule estimates on civilian reactors submitted originally and in 1957 571
Ashton, Henry R., New York Patent Law Association 559
Bates, Hon. William H., Member of Congress 565
Boskey, Bennett, of Volpe, Boskey and Skallerup 544
Casper, R. M., Allis-Chalmers Manufacturing Co 562
Cisler, Walker L., president, Power Reactor Development Co 528
Cocke, N. A., president, Carolina-Virginia Nuclear Power Associates, Inc 536
Doan, R. L., manager, atomic energy division. Phillips Petroleum Co 550
Ellis, Clyde, executive manager, National Rural Electric Cooperative Association 314
Fairman, James F., letter from, dated August 29, 1957, and reply to relative to power reactor at Indian Point, N. Y 463–464
Fields, K. E., general manager, AEC, letter from, to Chairman Durham, dated October 25, 1957, regarding AEC program to encourage industry to build chemical processing plants 502
Fluor, J. S., of the Fluor Corp., Ltd 550

Statements, letters, etc.—Continued Page
Gale, Willis, chairman, Commonwealth Edison Co 522
Gallagher, John P., director of utilities, city of Piqua, Ohio 540
Hoover, J. S., president, Canton (Ohio) Chamber of Commerce 553
Hottenroth, Fred W., vice president, Hupp Corp 553
Iddles, Alfred, president, Babcock & Wilcox Co 544
Kellogg, Fred C., president, Pioneer Service and Engineering Co 560
King, F. H., manager, city of Holyoke, Mass., Gas and Electric Department 540
Libby, W. F., Commissioner, AEC, letter from, dated January 3, 1956, to Senator Anderson, regarding AEC program to encourage industry to build chemical processing plants 501
Merritt, Philip L., of the E. J. Longyear Co 551
Moore, Irwin L., president, New England Electric System 527
Morehouse, E. W., vice president, General Public Utilities Corp 538
Morse, Richard S., president, Columbia-National Corp 555
Pace, Frank, Jr., president, General Dynamics Corp 557
Price, H. L., Director, Division of Licensing and Regulation, AEC, letter dated March 27, 1958, to James T. Ramey, executive director, JCAE, regarding license applications rejected because of hazards 91
Radin, Alex, American Public Power Association, letter dated March 11, 1958, to Chairman Durham 386
Santry, Joseph H., chairman, Combustion Engineering, Inc 566
Schacht, R. L., general manager, Consumers Public Power District 525
Spencer, Kenneth A., chairman, National Coal Association, Atomic Energy Committee 563
Starr, Dr. Chauncey, supplementary information on the support program 206
Steers, Newton I., Jr., president, Atomic Mutual Development Fund, Inc 546
Strauss, Lewis L., Chairman, AEC, letter dated March 29, 1958, to Chairman Durham, JCAE, relative to British inspection system 99
Strike, Clifford S., president, F. H. McGraw & Co 551
University of North Carolina 558
Vogel, Herbert D., Chairman, Tennessee Valley Authority 543
Webster, William, president, Yakeee Atomic Electric Co 526
Wilson, Carroll L., of the Metals and Controls Corp 543
Additional information supplied for the record:
Acceleration, subsidy backed by atom leaders in survey, from Nucleonics of February 1958 155
Access permit holders with access to C^{20} 28
Pending applications 31
AEC statement on raw material base for the atomic energy industry 105
AEC statement on scientific and technical manpower for the atomic energy industry 107
AEC press release announcing plutonium price schedules 68
AEC proposes to process spent fuels from private research and power reactors for interim period, press release, October 28, 1957 503
Agreements for cooperation as of April 1, 1958, status of 79
Arden House—final report of the 12th American Assembly, Harriman, N. Y., October 17–20, 1957, on atoms for power: United States policy in atomic energy development 414
Electric utility company participation in nuclear power development 376
Joint Committee press release announcing hearings and suggested topics of discussion 2
Kellogg Co., the M. W., copy of byproduct material license granted by AEC 516–517
Resolution adopted at second constitutional convention of the AFL–CIO, December 1957 304
Restricted data, transmission to other Nations, information on 26
State legislation and regulations in atomic energy field (table) 92
Status and prospects of nuclear power—an interim survey 467
Survey of scientific and engineering manpower needs of colleges and universities participating in atomic-energy activities exclusive of Government contracts, preliminary results of 57
The 1957 Nuclear Industry—What the AEC Expects of Industry, speech by R. W. Cook, October 28, 1957 503

Appendixes:

	Page
Appendix 1. JCAE summary of seminar with reactor experts, November 21, 1957	583
Appendix 2. JCAE summary of seminar with representatives of equipment manufacturers, November 22, 1957	584
Appendix 3. Forum poll favors expansion. [Reprinted from the Forum Memo of the Atomic Industrial Forum, Inc., February 1958]	585
Appendix 4. Reprint from Productive Uses of Nuclear Energy, by the National Planning Association Special Policy Committee	596
Appendix 5. 1958: Year of Decision in Atomic Power, address by Elmer L. Lindseth, president, the Cleveland Electric Illuminating Co	602
Appendix 6. Correspondence and information concerning proposed reactor project by Pacific Gas & Electric Co. at Humboldt Bay, Calif	608
Appendix 7. Excerpt from British publication entitled "Accident at Windscale, No. 1 Pile, on October 10, 1957"	616
Appendix 8. Correspondence concerning status of Latin American atomic power program	620
Appendix 9. Correspondence concerning information in foreign atomic equipment requirements and prospects	622
Appendix 10. Letter dated April 23, 1958, from Senator Clinton P. Anderson, vice chairman of Joint Committee, to Chairman Durham, commenting on statements submitted by AEC	623

DEVELOPMENT, GROWTH, AND STATE OF THE ATOMIC ENERGY INDUSTRY

WEDNESDAY, FEBRUARY 19, 1958

CONGRESS OF THE UNITED STATES,
JOINT COMMITTEE ON ATOMIC ENERGY,
Washington, D. C.

The committee met, pursuant to call, at 10 a. m., in room 457, Senate Office Building, Hon. Carl T. Durham (chairman of the committee) presiding.

Present: Representatives Durham, Holifield, Price, Dempsey, Van Zandt and Hosmer; Senators Anderson, Pastore, Hickenlooper, Bricker, Dworshak.

Also present: James T. Ramey, executive director, David R. Toll, staff counsel, George E. Brown, Jr., and Richard Smith, staff members, Joint Committee on Atomic Energy.

Chairman DURHAM. The committee will come to order.

These hearings, as you know, are intended to obtain "information concerning the development, growth, and state of the atomic energy industry" as required by section 202 of the Atomic Energy Act of 1954.

As a means of providing a partial agenda as to the topics in which the committee is particularly interested, we issued a press statement, together with an attachment outlining the general subject matter of special interest to the committee this year.

These general topics are as follows:

1. The raw materials program, and the Commission's program and policies for procurement of uranium ore;

2. The atomic power program, including the current status and prospects of atomic equipment manufacturers and the power industry. Testimony may cover both domestic and international aspects, including any comments as to the necessity or desirability for an accelerated program;

3. The availability of scientific and technical manpower, as it affects atomic industrial development;

4. The controlled thermonuclear program and problems of industry access to information and development;

5. AEC contract policy in the atomic power development field.

Special invitations were issued to AEC and more than 100 representatives of industry, cooperatives, labor, and other appropriate groups and individuals inviting them to appear before the committee. In addition, as mentioned above, we extended a general invitation to industry and the public concerning the hearings in the committee's press statement of January 27, 1958. Without objection, I would like to put the press release concerning the hearings in the record at this point.

(The press release referred to follows:)

SECTION 202 HEARINGS SCHEDULED

Congressman Carl T. Durham, Chairman of the Joint Committee, announced today that the Committee would hold its annual hearings on "the development, growth, and state of the atomic energy industry," as required by section 202 of the Atomic Energy Act, during the last 2 weeks in February 1958.

Mr. Durham stated that Chairman Lewis L. Strauss and other representatives of the Atomic Energy Commission were scheduled to testify before the Committee on February 18 or 19, 1958, to be followed by witnesses from industry and the public.

Mr. Durham made public a list of subjects in which the Committee is particularly interested this year, and on which comments would be welcome. (Copy attached.)

In commenting on the forthcoming hearings, Mr. Durham said:

"I have sent personal letters of invitation to a number of individuals or representatives of organizations who have appeared before the Committee in the past, or whom we know to be interested.

"In addition, the Committee is interested in comments from interested members of the general public. Comments may be submitted in writing and will be included in the record for consideration by the Committee, or oral testimony may be requested up to the time available."

Persons interested in submitting comments, or in testifying before the Committee during these hearings, should contact Mr. David R. Toll of the Committee staff in room F–88, United States Capitol Building, Washington, D. C. (Capitol 4–3121, extension 6171) on or before February 15, 1958.

JOINT COMMITTEE ON ATOMIC ENERGY

Section 202 hearings on the development, growth, and state of the atomic energy industry, 1958

SUGGESTED TOPICS FOR DISCUSSION

Listed below are subjects in which the Committee is particularly interested and would appreciate comments during this year's section 202 hearings:

1. The raw-materials program, and the Commission's program and policies for procurement of uranium ore.

2. The atomic-power program, including the current status and prospects of atomic equipment manufacturers and the power industry. Testimony may cover both domestic and international aspects, including any comments as to the necessity or desirability for an accelerated program.

3. The availability of scientific and technical manpower, as it affects atomic industrial development.

4. The controlled thermonuclear program and problems of industry access to information and development.

5. AEC contract policy in the atomic-power development field.

With respect to No. 5, comments are invited on AEC contract policies in both the governmental atomic-power development program and in the power-demonstration program (fee levels and overhead and reimbursable cost policies in AEC direct contracts; value of know-how as a consideration for an AEC contract; use of fixed-price contracts and closed end support in the power-demonstration program; etc.)

Concerning the civilian atomic-power program, the Committee would be interested in information both as to general progress and particular projects, including the following: Technical and other problems encountered; schedules and cost estimates, and revisions to original estimates; suggestions for improvement in the governmental and in the power-demonstration program.

The above is not intended to be a comprehensive list. There may well be other matters which individual witnesses may wish to discuss and which would be welcomed by the committee.

Chairman DURHAM. This year, as in previous years, a fairly representative group from the atomic-energy industry responded to the committee's invitation.

I don't propose today to provide any introductory comments on the state of the atomic-energy industry.

It has been the practice of the joint committee to request the Commission to lead off the section 202 hearings with a complete statement on the atomic-energy industry, and particularly with respect to the atomic-power program.

Today, by mutual agreement with the committee, it is understood that the Commission will defer its atomic-power presentation until the conclusion of the section 202 hearings, probably during the week of March 10.

It is hoped that, by then, the Commission will be in a position to come forward with a more definite atomic-power program, both domestic and foreign.

I wish to assure the atomic-energy industry that, once a definitive program is submitted to the committee, the industry will have an opportunity to review it thoroughly and submit comments and testimony in connection with legislative proposals on the subject.

This review will be in connection with annual authorization legislation or bills to accelerate the atomic-power program. In the event that an acceptable program from AEC does not materialize, the Joint Committee will, of course, endeavor, as in the past, to come up with a program and projects of its own.

It is my earnest hope, and I believe I speak for our members, that these hearings, and the discussions and hearings which follow, will result in a program which will insure American leadership in atomic-power technology throughout the world.

Mr. Strauss, we are glad to have you and your associates in the Commission here with us today. I understand you will lead off, and your associates will also cover parts of the presentation.

I want to thank you and your staff for their cooperation in the planning and preparing for the hearings. Due to the deferral of the atomic-power presentation, it was, of course, necessary to consolidate some of the Commission's testimony.

Copies of the revised statement were not received until last evening and this morning, so you may find that some of us may have a little trouble in following you.

Would you proceed, Mr. Strauss?

Senator ANDERSON. Mr. Chairman, I wonder if I could get clarification concerning the power aspect of this hearing. It says the Commission will defer its atomic-power presentation until the conclusion of the 202 hearings. Surely, this is going to be a part of the 202 hearings, is it not?

Chairman DURHAM. Surely. It will be part of the 202 hearings, but at the end of them.

Senator ANDERSON. You mean at the end after all the testimony is in?

Chairman DURHAM. That was the agreement, as I understood it. It will be included in the 202 hearings, but it will be taken up at the end because of some of the problems created with the Bureau of the Budget, and so forth.*

Mr. Strauss, we are glad to have you with us and you may proceed with your statement.

---

*For concluding statements of AEC, see pp. 569–581.

STATEMENTS OF LEWIS L. STRAUSS, CHAIRMAN, UNITED STATES ATOMIC ENERGY COMMISSION; W. F. LIBBY, COMMISSIONER; JOHN S. GRAHAM, COMMISSIONER; JOHN F. FLOBERG, COMMISSIONER; K. E. FIELDS, GENERAL MANAGER; EDWARD DIAMOND, ACTING GENERAL COUNSEL; CHARLES L. MARSHALL, DIRECTOR, DIVISION OF CLASSIFICATION; MORSE SALISBURY, DIRECTOR, DIVISION OF INFORMATION SERVICES; OSCAR S. SMITH, DIRECTOR, DIVISION OF ORGANIZATION AND PERSONNEL; JESSE C. JOHNSON, DIRECTOR, DIVISION OF RAW MATERIALS; DR. PAUL W. McDANIEL, ACTING DIRECTOR, DIVISION OF RESEARCH; AND DR. FRANK PITTMAN, OFFICE OF INDUSTRIAL DEVELOPMENT, UNITED STATES ATOMIC ENERGY COMMISSION

Mr. STRAUSS. Thank you, Mr. Chairman and members of the committee. My colleagues and I are very happy to have this opportunity of meeting with you this morning at the opening of your committee's review of the atomic industry to give a summary of the Commission's general views on the growth, development, and status of the industry during the past year. We have divided the presentation into sections. This order is without any significance other than convenience. The sections are: (1) Progress in the field of controlled thermonuclear research; (2) the industrial use of radioisotopes; (3) manpower; (4) information base for the atomic-energy industry; (5) raw-materials base for the atomic-energy industry; (6) supplying a developing atomic industry; (7) Government policy on prices, charges, and patents; (8) United States industry's role in international cooperation; (9) regulations and licensing.

The growth and development of the atomic industry in both its private and governmental phases during the past 3½ years under the Cole-Hickenlooper Act of 1954 have been described in detail by excerpts from the Commission's 23d semiannual report which has been filed with you as the Commission's general written testimony.

In the advance toward nuclear power in this country, in other than its military applications, 1957 was the year of greatest achievement to date. By the end of the year we had clearly established the technological feasibility of nuclear power. Six power reactors, representing five different civilian power concepts, went into operation during the year.

The view of the free world on our accomplishments was expressed during the past year by a committee representing the six western European countries which have joined to form Euratom. After a thorough survey of atomic-power development in the most advanced nations, this committee, known as the Three Wise Men, reported:

> An impressive amount of research and development done both through the AEC and private industry has provided America with the most complete nuclear foundation in the world.

The principal question now is: Which are the ways that will give us nuclear power at competitive cost per kilowatt-hour?

The Commission has continuously given careful consideration to this question. The United States program remains unchanged; it is to attain safe, reliable, and economic nuclear power at home and abroad as soon as possible.

As you are aware, the timetable is shorter for reaching competitive power abroad, since many of our friends find it necessary in their national interest to achieve a degree of independence from the importation of chemical fuels.

Our conclusion—which we have communicated to your committee—is that we should try to reach this objective of successful aid to our friends in attaining competitive nuclear power within 5 years. That is, it is our hope that in another 5 years we will be able to begin design and construction of large nuclear powerplants which will produce economic nuclear power in a large part of Western Europe, in Japan, and elsewhere.

To arrive at commercially competitive nuclear power in the United States is expected to require a longer time owing to the lower price and greater availability here of conventional fuels.

The report of Euratom made it clear that the western European countries which formed that group could profitably use up to 15 million kilowatts of nuclear electric power by the end of 1967.

The report stated that the shortage of energy threatens to become a major brake on economic growth and that the increasing burden of importation of conventional fuel, would seriously strain the economy of those friendly nations.

Their conclusion, with which we cannot differ, was that nuclear power appears to offer a solution to their problem. They believe that the attainment of this goal at the desired rate is possible only through a close partnership with the United States and other nations of the free world.

Recognizing the importance to the President's program of economically strong allies and taking full advantage of United States leadership in nuclear technology, we look to the development of close, mutually beneficial cooperation with Euratom, which is now completing its organization.

Representatives of the AEC and the Department of State are currently engaged—at the request of President Armand—in preliminary discussions with the Euratom Commission.

If the Euratom Commission decides, in connection with its overall program, to encourage the early construction of a number of large power reactors in Europe, we must be prepared to give them full cooperation and appropriate assistance. As soon as the plans for their program take shape we will want to advise the Joint Committee further of the nature of these plans and the areas where specific cooperation is indicated.

Obviously, cooperation with Euratom would be a major step in an overall program which would also recognize the needs of other nations or communities of nations and most importantly, the working out of means to supply strong support to the programs of the International Atomic Energy Agency as they are developed by Director General Sterling Cole, and the able staff which he is assembling in Vienna. If our hopes bear fruit this may become the most important contribution to world pleace in our lifetime.

The basis of United States leadership in atomic-energy development with particular reference to the progress made in the calendar year under review in the area of nuclear-power development is described on pages 77 through 125 in those portions of the Commission's 23d

Semiannual Report which, as I have stated, are submitted as a part of this presentation. Therefore I shall not repeat that text at this point, unless you desire it, but I ask that it be made a part of the record here.

Chairman DURHAM. Without objection it is so ordered.

Senator ANDERSON. How much of it? There are 200 pages.

Mr. STRAUSS. Pages 77 through 125, a little less than 50 pages, Senator Anderson.

Senator ANDERSON. Why do you want to reprint the pages since you already have them in an annual report which is a part of this hearing?

Mr. STRAUSS. I have no feeling about any illustrations, Senator Anderson. The text is what I would like to have included.

Senator ANDERSON. How about the tables that are in the back part of the report?

Mr. STRAUSS. I think that if the tables are pertinent to the text and referred to in the text that it would be proper to include them. I don't feel strongly about this if the committee wishes to exclude it. It might be incorporated by reference.

Chairman DURHAM. The only thing I was thinking about is the cost of it. If you could just refer to it, and it is satisfactory to you, it would be satisfactory to the committee.

Mr. STRAUSS. It is satisfactory to the Commission to include it by reference.

Chairman DURHAM. Without objection it will be included by reference.

Mr. STRAUSS. Also, as you are aware, Mr. Chairman, informal discussions are presently being held between the staffs of the Joint Committee and the Commission on policies and proposals for the future scope of the nuclear power development program. This is the matter to which you referred in your introduction. In view of these discussions, it has been suggested that we defer until later in these hearings testimony dealing with future planning in the area of nuclear-power development.

However, in keeping with our precept to keep you currently informed, I should like to read a telegram which I received this morning and the substance of which will be made known later today in San Francisco. This is a telegram dated February 18, and handed to me here this morning. It is signed by N. R. Sutherland, president and general manager—then there is a garble, I can't make out the name—addressed to me and reads as follows:

Supplementing our discussions with AEC staff—

Senator HICKENLOOPER. Mr. Chairman, president of what?

Mr. STRAUSS. President of the Pacific Gas & Electric Co.*

Supplementing our discussions with AEC staff, the Pacific Gas & Electric Co. in addition to financial participation with the nuclear-power group in the research and development work for the Dresden atomic powerplant and our partnership in the Vallecitos atomic powerplant will, as a third step, subject to receiving the usual permits, licenses, and certificates, install and operate a 50,000-kilowatt rated boiling water atomic power unit which we expect will produce 60,000 kilowatts of electric power.

The location will be our Humboldt Bay powerplant, south of Eureka, Calif. The boiling water atomic unit will have a normal thermal rating of 165,000 kilowatts and will include several nuclear advances such as (*a*) complete internal

*For further information concerning project proposed by Pacific Gas & Electric Co., see pp. 608–615.

steam separation and dryers, (*b*) largest steam flow using single-cycle principle, (*c*) largest reactor with natural circulation, (*d*) refueling method and equipment of advanced design. Completion date not later than middle of 1962. We have completed negotiations on a regular commercial basis with Bechtel Corp. to design and build a plan on a turnkey fixed price basis. General Electric Co. will supply the nuclear and electrical equipment. Nuclear fuel will be fabricated by General Electric Co. under a separate contract.

No financial assistance to us is involved in these contracts. No assistance from AEC for research and development is contemplated. Eureka is in a moderately high-fuel cost area and other favorable factors are present. Consequently, we believe that this atomic powerplant producing 60,000 electrical kilowatts should achieve competitive power costing 8 mills with the second core and present plutonium credit. We expect to approach this goal with the first core. Furthermore, as a fourth step, we shall, as stated previously, continue our work to reduce the cost of the 200,000 kilowatt atomic electric unit we desire to install when we achieve our cost goals for this larger unit.

Senator ANDERSON. Mr. Chairman, if we are going to get into this question of power reactors and whether or not private industry is going ahead, I think it might be appropriate to quote part of a page from Time magazine for February 10. I read:

Even the biggest companies find the going rough. General Electric—because it is referred to in here—originally put a price of $45 million on the Dresden, Ill., nuclear powerplant, 180,000 kilowatts, it is building for Chicago's Commonwealth Edison Co.

Costs already exceed that by an estimated $20 million. By the time it is finished, GE will be $80 million in the hole on its nuclear program including a smaller 5,000-kilowatt plant built for experience at Pleasanton, Calif. GE, like others, thinks if it could build three big plants in a row it could earn enough to produce competitive power. But GE has no plants at the moment. Private industry has found there is no money in AERG and no prospect of making any money.

I don't know where this telegram came from, I don't believe it was discussed by anybody, and I thought there was some discussion that we would leave the private power argument out. I do notice that the Chairman of the Commission says that it is our hope in another 5 years that we will be able to begin the design and construction of large powerplants which will produce economic nuclear power in a large part of Western Europe and elsewhere. So by 1963 we can begin to look forward to a time when things can happen. Commercially competitive nuclear power in the United States will require a longer time.

The interesting thing is that the statement is made that the program of the Atomic Energy Commission is unchanged. So, I assume, Mr. Chairman, that you mean by that to say that those of us who believe there ought to be some change should just start to gird our loins and get ready for it.

Mr. STRAUSS. Senator, you asked several questions.

Senator ANDERSON. Yes, I did because I didn't understand that today, under the agreement that was reached, that we would get into a discussion of the merits of public and private power. The telegram was quite obviously read to show that here stands private industry just itching to build these powerplants.

Representative PRICE. Senator, wouldn't you agree with me that the program must not be doing as well this year as last year because last year at this time we had four such telegrams?

Mr. STRAUSS. May I respond, Mr. Chairman?

Chairman DURHAM. In fairness to Chairman Strauss, he showed me the telegram here. I didn't read it in detail. I saw it was private power investment paying for it entirely. I thought probably it

would come under our agreement to discuss this power question at the end of the hearings. Whether it does or does not cover that agreement, I am not able to determine, because it is built entirely out of private funds and we don't participate in it whatsoever according to the reading of the telegram.

Mr. STRAUSS. Mr. Chairman, you will appreciate that the Commission is somewhat on the horns of a dilemma. I received this telegram this morning. I told you that I thought I should present it. Had I not done so and this material been released to the press, as undoubtedly it will be later in the day in San Francisco, I am caught in the nutcracker of not keeping you fully and currently informed. I will reason the fact that this statement was prepared prior to the receipt of the telegram and I interpolated the telegram this morning.

It is true that last year, as Mr. Price states, there were a number of proposals advanced by companies and most of them have been firmed up in the nature of projects which have been begun.

I will defer any discussion on this.

Senator ANDERSON. Which ones have been begun?

Mr. STRAUSS. A plant has been begun at Dresden, a plant has been begun at Indian Point.

Senator ANDERSON. We didn't have a telegram on Dresden last year. You said on the four telegrams they had been firmed up and work had been begun. Which ones had been begun?

Mr. STRAUSS. I did not say it.

Senator ANDERSON. Mr. Reporter, read the statement.

(The statement was read by the reporter.)

Mr. STRAUSS. I would like to observe that the use of the number four was not made by me.

Senator ANDERSON. You said, "As Mr. Price states." Do you want the reporter to read what Mr. Price states?

Mr. STRAUSS. I did not confirm the number that Mr. Price stated. There were some telegrams last year with respect to the intention of power companies to enter into contracts to build plants and a number of them have been begun.

Senator ANDERSON. How many of those have been started? You said there were four telegrams sent in.

Mr. STRAUSS. Mr. Goodman, have you any recollection as to the number of messages received last year?

Mr. GOODMAN. Mr. Chairman, there are so many things that happen in this field so fast during the year that for me to be able to reconstruct exactly which four companies is an impossibility at this point, I am afraid.

Representative PRICE. It could not have been Dresden because the Dresden proposal predated last year by several years.

Mr. STRAUSS. Senator Anderson, if this matter is of concern to you with respect to detail, may I supply for the record the precise number of communications and the precise status of the development which has resulted from them since none of us here at this table has this recollection, and Mr. Davis the Director of the Reactor Development Division is ill, and Mr. Roddis, the second in command, is snowed in and could not get here this morning. We have no desire to withhold this vital information from the committee.

(The material referred to follows:)

The following communications which were made a part of the report of the 1957 JCAE 202 hearings indicated proposals being submitted in response to the third invitation or advised the Commission of an active interest in atomic power possibilities. The full text of these communicatons is set forth on pages 27 through 30 in the report of the 1957 202 hearings.

1. Letter dated February 18, 1957, to Lewis L. Strauss from Philip Sporn, representing American Gas & Electric Service Corp. and other utility companies operating in the Ohio Valley and contiguous areas.

2. Press release by Paul B. McKee dated February 19, 1957, in behalf of Pacific Power & Light Co. and other utilities.

3. Telegram dated February 18, 1957, to Lewis L. Strauss from N. R. Sutherland, president, Pacific Gas & Electric Co. There follows a discussion concerning the developments of these three proposed projects during the past year.

1. *American Gas & Electric Corp., etc.*—This group of utilities known as the east central nuclear group along with the Florida west coast nuclear group last December submitted a proposal in response to the Commission's third invitation for the design, development, construction and operation of a high temperature, gas-cooled, heavy water-moderated, pressure tube reactor of 50,000 electrical kilowatts capacity. This proposal has been conditionally approved by the Commission as basis for contract negotiation subject to receipt of the necessary congressional authorization which has been requested.

2. *Pacific Power & Light Co., etc.*—Available resources of this company as well as other private utilities of the Pacific Northwest will be severely taxed for some time to come by the need for substantial expansion of generating capacity to offset loss of Bonneville power. However, these companies are continuing the study of the development of atomic power looking toward the eventual construction of a nuclear powerplant.

3. *Pacific Gas & Electric Co.*[1]—This company advised the Commission by telegram of February 18, 1958, of its plans for a nuclear powerplant near Eureka, Calif., independent of governmental financial assistance. The details pertaining to this nuclear powerplant are contained in the telegram which was made a part of the record of the February 19, 1958, 202 hearings.

Senator ANDERSON. The Hanford Atomic Energy Works have made 14 square miles available to Pacific Power & Light Co. That is not what you have. Is that what you were talking about today? Who is the telegram from?

Mr. STRAUSS. The telegram is from Mr. N. R. Sutherland, president of the Pacific Gas & Electric Co.

Senator ANDERSON. That is a different outfit. One of the telegrams last year was from Paul B. McKee:

Acquisition by Pacific Power & Light Co. of about 14 square miles of land near the Hanford Atomic Energy Works Reservation, have a site available for a future atomic powerplant was announced Tuesday.

That got into the hearing last year. Has anything happened in the intervening year?

Mr. STRAUSS. I am unable to answer the question. I assume they acquired the land if they stated that they did.

Senator ANDERSON. You read that telegram talking about Bechtel going into this. Is Bechtel in the Dresden plant also?

Mr. STRAUSS. I am unable to answer.

Senator ANDERSON. I can. I can tell you he is with General Electric. Would you think the experience on the Dresden plant is going to get their enthusiasm up very high?

Mr. STRAUSS. Whose enthusiasm?

Senator ANDERSON. Bechtel and General Electric.

[1] For further information concerning the Pacific Gas & Electric Co. proposed project see appendix, pp. 608–615, of these hearings.

Mr. STRAUSS. If this statement is correct, and I have no reason to doubt it a contract has been completed. The telegram says:

> We have completed negotiations on a regular commercial basis with the Bechtel Corp. to design and build a plant on a turnkey fixed-price basis.

I have no reason to question the accuracy of that statement. I believe it to be so.

Senator ANDERSON. They are going to have a turnkey basis. I thought GE got all the turnkey basis it wanted on the Dresden job.

Mr. STRAUSS. You may know more about it than I do.

Senator ANDERSON. I am just reading what Time magazine printed here.

Mr. STRAUSS. I think the actions speak louder than words.

Senator ANDERSON. I wonder if the treasurer of GE will believe that?

Mr. STRAUSS. I am unable to answer.

Chairman DURHAM. Proceed with your statement, please.

Mr. STRAUSS. Thank you. 1957 accomplishments which are cited in the Commission's 23d semiannual report to the Congress have been possible because of the way in which the outstanding skill of our scientists and engineers has been correlated with the leadership, organization and financial encouragement of the Federal Government, and the ingenuity, initiative, and managerial capacity and capital investment of our free enterprise system.

I will now present the subject of controlled thermonuclear power following which my colleagues will review the record of 1957 in the 8 other fields and which are related to the growth and development of the atomic energy industry.

We might begin by summarizing the progress which has occurred in this program known as project Sherwood. Both the United States and the United Kingdom have had some success in experiments looking toward the establishment of economic controlled thermonuclear power. By prearrangement last fall, both nations issued on January 24 scientific papers and official comment on the results attained in one line of research being followed by both nations. Both the United States and the United Kingdom announcements made it clear that fruitful and promising results had been achieved in the laboratories of both countries but that we could not expect early harnessing of fusion for the production of power.

In controlled fusion we are not yet at a point comparable to December 2, 1942, when the first self-sustaining controlled fission reaction was obtained by Dr. Fermi.

As we stated in December, and as is borne out in the newly issued scientific papers, both we and the British have succeeded in producing and maintaining quite high temperatures in a plasma of light nuclei, and the containment of such a plasma for brief but nevertheless appreciable lengths of time. But it is clear that much longer containment must be achieved and much higher temperatures reached.

We are making important progress, but the problems are formidable and it will be a matter of years before we will be able to build and operate commercial reactors utilizing the deuterium of the oceans, thus to produce electrical power and provide a source of energy sufficient for man's expanding needs for ages to come.

The Commission has been conducting some research in the field of controlled thermonuclear reactions since 1951, but did not begin to expend significant sums of money on it until 1954. This research is carried out at Los Alamos Scientific Laboratory, Oak Ridge National Laboratory, Princeton University, the University of California Radiation Laboratory, Berkeley and Livermore, and at several other smaller university and industrial contractor sites.

The work in this field consists of a number of alternate approaches leading toward the development of a method that will achieve a controlled release of energy from nuclear fusion.

The problem involved in controlling a thermonuclear reaction is that of ionizing a suitable material such as deuterium, heating the resulting plasma to a temperature of about 100,000,000° C. or higher, and confining the plasma at this temperature long enough to permit an appreciable fraction of the ions to fuse with a consequent release of energy. The energy thus released must then be converted into electrical power.

Since 1951 the level of research in this area has greatly expanded and a number of interesting developments have occurred, but all of the work is still very much in the research stage.

The United States and the United Kingdom have had a full exchange of information on the progress in their controlled thermonuclear reaction work.

The January 24 press releases concerning the recent developments in British and United States programs were followed on January 25 by the publication of technical papers for the scientific world, partly through the British scientific weekly, Nature, and partly in the following week in the United States in the scientific journal, the Physical Review. I shall now summarize the progress that has taken place at the four major laboratories in the United States and also give you a brief synopsis of the developments reported in the scientific papers issued on January 25.

During 1957 the Commission approved the construction of a complex of laboratories and power facilities at Princeton University. This complex is known as the model C stellarator project and is expected to come into operation in fiscal year 1960.

These facilities will be employed for the next 10 years in experimenting on several large machines. The thermonuclear devices that will be housed in the new complex are not to be expected to produce net power. Instead they are considered to be research devices pointing the way, we hope, to net power producers.

At Los Alamos Scientific Laboratory scientists have been studying the phenomena associated with the discharges of large electrical currents through cylinders containing deuterium gas. When such currents are created, the ionized gases tend to contract, or pinch, into a slender filament in which it is hoped that the fusion reactions can take place, and in which configuration the plasma is held away from the walls of the cylinder.

Success with small devices using this principle make it imperative that larger and more powerful devices be developed and tested. Accordingly, approval has been given for a new building to house a large bank of condensers and other electrical equipment, necessary for the experiments.

Several of the Los Alamos pinch devices have produced neutrons in considerable quantity. For several years, in several nations it has been easy to secure neutrons from electrical discharges.

These neutrons were believed to be produced when deuterons escaped from the discharge and struck the walls covered with deuterium.

However, due to a theoretical advance at Los Alamos in 1956, our physicists have learned how to stabilize these discharges; that is, to keep them from striking the walls. Therefore, a large proportion of the neutrons now observed is believed to be thermonuclear, in the sense that they arise from collisions of deuterons within the gas—each nucleus serving as a projectile or as a target.

Temperatures of several million degrees have been attained by some of the discharges under study at Los Alamos and from 1 million to 100 million neutrons have been observed during each discharge.

Four of the technical papers that were published on January 25 described developments at Los Alamos Scientific Laboratory in considerable detail.

Mr. Chairman, my statement at this point, includes a brief description in lay language of these papers. I will, if you will permit me, omit the reading of this since your committee has had extended hearings from the scientists themselves who were engaged on this project and offer these pages for the record, but I am prepared to read them if you wish.

Chairman DURHAM. Without objection, they will be included in record.

(The document referred to follows:)

The first paper dealt with the development of a method for determining the effective temperature of the hot gas. This technique was fully described by Drs. Burkhardt, Lovberg, and Phillips in their paper.

The second paper by Drs. Hagerman and Mather described the production of neutrons in the plasma produced in a cylindrical tube through which a large electrical current was discharged momentarily. This pinch apparatus, the Columbus II, began to yield significant results last summer. It was designed to put as much electric power as forcible into the pinch tube in as short a time as possible. Under various conditions the tube can be made to yield between 10 million and 100 million neutrons per pulse and they are emitted in a time about one-millionth of a second.

When these neutrons were found, exhaustive tests were undertaken to determine whether most of them were produced by a thermonuclear method or whether they were emitted from other reactions occurring at the electrodes or at the walls, or from instabilities in the gas. The number of neutrons was reduced somewhat by the application of a weak magnetic field but this is to be expected according to current theory. The neutron yield increased by a factor of 2 when the voltage was raised from 40 to 50 kilovolts. By catching the neutrons in very sensitive photographic plates placed around the discharge tube it was possible to study the probable mode of origin of the neutrons. It was found that there was a group of deuterons traveling toward the cathode at high speed. This group of deuterons was found to be producing some of the observed neutrons. Nevertheless, the results were encouraging because it was found that the neutrons were being emitted from the gas practically uniformly from all parts of the tube, except in a region about 2 inches long near the anode.

The third paper by Drs. Burkhardt and Lovberg dealt with a straight pinch tube, called Columbus S–4. It was used to study the effect of greater length and greater tube diameter on the behavior of the pinch discharge. In this case the discharge tube was a porcelain cylinder 5 inches in diameter and 24 inches long. In this tube it was shown that there can be circulating currents in the tube at certain times during the pinch process. There are indications that particle energies of 300 electron volts (or temperatures of about 3 million degrees) were attained. When the tube was started with pressures of only 40

microns of mercury (about one fifty-millionth of an atmosphere), the pressure in the pinched discharge became equivalent to about 12 atmospheres at the time when the diameter of the current column was smallest. This occurs about 6 microseconds after the current discharge starts.

Perhaps the most significant observation with this apparatus was that the field produced by the pinch current is highly reproducible over several half-cycles of the applied voltage.

The fourth paper, by Drs. Honsaker, Karr, Asher, Phillips, and Tuck, described the production of neutrons from a stabilized pinch in a small doughnut-shaped tube, called Perhapsatron S–3. This device came into operation in December 1957. This small tube yields as many as a million neutrons per discharge, under suitable conditions. The main burst of neutrons occurred in a time of about 2 microseconds. Smaller bursts continue to occur for several additional miroseconds. These scientists found that the results are consistent with a temperature of about 6 million degrees. There was good evidence that the pinch was well centered while the discharge current was large. The pinch discharge undulated slightly, but the motion had only a small amplitude compared to the tube radius. These observations suggest that the discharge was well stabilized. Of course, a well-stabilized plasma is of extreme importance to the program.

Now that this degree of success has been attained, it is possible and desirable to scale up the Los Alamos apparatus, in power and (to some extent) in size. We may expect to hear of higher temperatures and longer containment times in the months and years ahead.

The controlled thermonuclear program at Oak Ridge National Laboratory has been greatly expanded in the past year. The laboratory has organized a new division, the Thermonuclear Experimental Division, which has grown to about three times its original size during the past year. Important progress is being made at this site.

At the University of California radiation laboratory at Livermore work has continued with a variety of promising machines which may produce thermonuclear neutrons in the very near future.

Mr. STRAUSS. I would resume, then, my prepared statement.

We have been so encouraged by the steady stream of advances in all of the major laboratories that we are beginning to consider the problems involved in large pilot devices and in machines which, according to theory, should produce net power. In the past year studies of chemical and material problems began on a small scale at Oak Ridge National Laboratory. Arrangements are being made for the participation of other laboratories especially skilled in these fields.

The road to controlled thermonuclear net power production is long and hard and we cannot afford to overlook the possibility that difficulties still unforeseen may slow our progress. It is impossible to say when a net power producer might be achieved but the most optimistic estimates by those who are familiar with the difficulties are of the order of 20 years. I might interpolate that having less of that familiarity with the difficulties I personally indulge in more optimism. It would be after that that we would turn to the development of machines producing commercially competitive power.

In addition to the technical progress of the controlled thermonuclear program, the committee has indicated that it is interested in any comments which we have on the problems which industry might be encountering in obtaining access to information in this field.

It is our opinion that all persons or companies actively interested in, and capable of contributing to research and development programs aimed at achieving controlled thermonuclear reactions are able to qualify for access to all Commission generated classified information on the subject.

In addition, it is possible for those who are actively engaged in fission-power programs to keep abreast of the progress of the thermonuclear program in order that they may determine whether their efforts in the fission program are being made obsolete by advances in the potentially competitive field. Up to this time, approximately 100 companies and private individuals have been authorized to obtain access to all classified information in the field.

Senator ANDERSON. How many companies and individuals have been refused access, and on what grounds?

Mr. STRAUSS. Is there any one here who can answer that? May we supply that for the record, Senator? My belief would be that it is a very small number indeed.

Senator ANDERSON. Have people been refused on the grounds that they didn't have any need to know?

Mr. STRAUSS. I cannot answer presently as to the grounds on which refusal has been made, but that will be supplied for the record. (See p. 28.)

Senator ANDERSON. Someone must know. Doesn't someone know whether anyone has been refused on the grounds that they didn't need to know?

Mr. STRAUSS. We will provide an answer to that.

Mr. PITTMAN. Mr. Chairman, I will provide a detailed answer if you wish, but in general there are a few people and companies who have requested access to the controlled thermonuclear who do not meet the criteria as published in our regulations and therefore did not show a need-to-know to access.

Senator ANDERSON. Could we have an easier answer. Have there been people who have been refused information on the grounds that they did not need to know?

Mr. STRAUSS. Refused on the grounds that their work does not show a need to know as published in our criteria published in our regulations?

Mr. FIELDS. Senator, basically our criteria are that they should be engaged in the development and construction of a nuclear powerplant, not a thermonuclear powerplant, to have access or to be actively engaged in research in the controlled thermonuclear process. Those are fundamentally the criteria we have used for access, which means it is based on what we judge to be a need to know.

Representative PRICE. What about investment houses, and so forth?

Mr. FIELDS. If they have an active investment interest in a nuclear powerplant they have some degree of access.

Representative PRICE. Are there any other groups outside of people engaged in the nuclear powerplants construction that have access?

Mr. FIELDS. Those two principal points are the basic criteria.

Senator ANDERSON. An investment house with some interest in the stock of a company that is building a nuclear powerplant can get it. That one that does not have it, cannot get it.

Mr. FIELDS. It is slightly narrower than that.

Senator ANDERSON. If I have a share of stock in General Electric, which is building a nuclear powerplant, and a magazine says they may be $80 million in a hole, have I a right to access as such?

Mr. FIELDS. No, sir; you do not.

Senator ANDERSON. But an investment house would have.

Mr. FIELDS. I believe our criteria restrict it to the engineering and development unless there is a demonstrated pertinence to the supporting funds for the project.

I will have to review that and supply a statement (see p. 16.)

Mr. STRAUSS. Senator, the discussion is academic to this degree: That practically all of this information is declassified.

Senator ANDERSON. On thermonuclear; is it?

Mr. STRAUSS. Practically all, except those aspects that we think may have a weapons application.

Senator ANDERSON. How much do you think has a weapons application—all of it?

Mr. STRAUSS. No; I would say that if one could measure it, 95 percent of it is in the open area today.

Representative PRICE. Has it all been—you say 95 percent of the information on thermonuclear control has been declassified?

Mr. STRAUSS. It is obviously inaccurate to measure it in terms of percent. One can't figure it that way, but the great bulk of the information in the controlled thermonuclear field is in the declassified area and has been for some recent time.

Representative PRICE. We have not had any such information given to us before. It was not indicated in hearings that we have had on the subject.

Mr. STRAUSS. That has been publicly stated, Mr. Price, in statements which have been made in connection with our cooperation with the British.

Senator ANDERSON. Aren't there a host of papers that have not been declassified—stacks of them?

Mr. STRAUSS. I wouldn't know whether there are stacks. There is a substantial amount of paper but their relationship to the totality is small.

Senator ANDERSON. Then if it is so easy to get it, how many applications for access are now pending?

Mr. STRAUSS. I can't answer but I can supply it.

Senator ANDERSON. How long have they been pending? Can somebody answer?

Mr. PITTMAN. There are none pending right now unless it is just the workload of this particular week.

Senator ANDERSON. No application for access are pending?

Mr. PITTMAN. Unless it is just workload that has not gotten to us within the week or 10 days. There is no long list of pending applications for this category.

Mr. FIELDS. Senator Anderson, I have the exact language of the regulation that has been issued if you would like me to read it.

Senator ANDERSON. Does it differ from what was in the so-called McKinney report?

Mr. FIELDS. Yes; I believe it does.

Senator ANDERSON. That said:

Although solution of the problems involved can by no means be regarded as sure, it appears that any thermonuclear reactor will be a substantial neutron producer, capable of producing substantial quantities of special nuclear material. Hence, it is our opinion that information related to controlled thermonuclear reactions is data concerning the production of special nuclear material and falls within the definition of restricted data as defined in section 2 (4) of the Atomic Energy Act of 1954.

That pins it down pretty tight.

Mr. FIELDS. It does if you follow that literally. Since that time a considerable declassification has taken place and a modification of the categories that would be unclassified.

This has moved much farther down the road than in the McKinney report. What I was referring to, Senator, has to do with the criteria for access to thermonuclear information which you had asked about previously. I have that if you wish it. This is a regulation issued on August 9, 1957, published in the Federal Register. I will not read the entire regulation but here is the part that is effective upon publication in the Federal Register. Subparagraph 2 of 25.15 (b) is amended to read as follows. This is the criteria:

An application for access to secret restricted data in category C–20, controlled thermonuclear processes, will be approved only if the applicant demonstrates, also, that the applicant (1) is directly engaged in a substantial effort to develop, design, build, or operate a fission-power reactor that is planned for construction, and is making or proposes to make a comparative evaluation of fission and controlled thermonuclear processes for production of power, or (2) possesses qualifications demonstrating that he is capable of making a significant contribution to research and development in the controlled thermonuclear field and is directly engaged in or proposes to engage in a substantial study program or a substantial research and development program in this field, or (3) is furnishing to a permittee having access to C–20—that is to this information—substantial financial assistance or substantial scientific, engineering, or other professional services to be used by said permittee in carrying out the activities for which said permittee received access to category C–20, or (4) is furnishing to a permittee having access to C–20 under subdivision 2 of this subparagraph substantial financial assistance or substantial scientific, engineering, or other professional services to be used by said permittee in the study or research and development program for which said permittee received access to category C–20.

Senator ANDERSON. If a man is just a plain ordinary college professor, could he get access? He might not be able to say that his scientific studies were going to do anything remarkable. He might be like Dr. Goddard who designed the V–2 rocket almost in exact detail as the one by Dr. von Braun and used by the Germans. He didn't have any idea of using them for warlike purposes. Would you read clause 2 again?

Mr. FIELDS (reading):

Possessing qualifications demonstrating that he is capable of making a significant contribution to research and development in the controlled thermonuclear field and is directly engaged in or proposes to engage in a substantial study program or a substantial research and development program in this field.

In other words, if a professor intended to do research, if you thought he promised real development or work on it, he would be eligible for clearance.

Senator ANDERSON. How would you decide whether he was going to come up with a remarkable invention and whether he will be a Thomas Edison or a large flop?

Mr. FIELDS. You have to use judgment to a large extent.

Senator ANDERSON. He has to satisfy you that he is able to make a substantial contribution.

Mr. FIELDS. A substantial contribution doesn't necessarily mean that it will have success, Senator, in the development field. You have to know the area in research when you are dealing with it. You have to have familiarity with the competence of the people.

There may be avenues that are not being explored that you think should be explored, you may not be able to say you are going to have success, but it would warrant going ahead with it.

Senator ANDERSON. Dr. Einstein was a patent clerk, wasn't he when he made his famous pronouncement?

Mr. FIELDS. I don't know.

Senator ANDERSON. Fifty years ago he was a patent clerk. When he made his announcement did anybody pay any attention to it?

Mr. FIELDS. I don't know, sir.

Senator ANDERSON. No.

Mr. STRAUSS. It was published in the most respectable scientific journal of the day and received wide attention among the scientific community that was then prepared to understand. He was not ignored.

Senator ANDERSON. Then prepared to understand it; yes.

Representative PRICE. May I ask a question?

Chairman DURHAM. Yes.

Representative PRICE. Do any individual scientists as individuals have access to this information?

Mr. FIELDS. I can't answer that, Mr. Price. What was the question?

Representative PRICE. Do any individual scientists in our universities or laboratories, as individuals, have access?

Mr. STRAUSS. I think we can answer this question best by supplying you with a list of all of those to whom access permits have been granted and those to whom they have been denied, and that will be done as soon as we can get our personnel out to our office in Germantown. (See p. 28.)

Senator ANDERSON Can we get one final statement on this? There have been people who have complained that they are not able to get an access permit, and it is my understanding that there are people who have written—I am speaking now from memory and may be wrong—and have told me that their applications are pending. Your statement a moment ago is that there is not a single one pending; except for the last few days.

Mr. PITTMAN. I think that is right.

Senator ANDERSON. All of them have been rejected or accepted.

Mr. PITTMAN. I think that is correct, sir.

Chairman DURHAM. You may proceed with your statement.

Mr. STRAUSS. I have just one more paragraph, Mr. Chairman.

It is further our opinion that these groups, through reports, discussions, laboratory visits, formal meetings, and other means, are able to obtain a clear, detailed, and up-to-date picture of the status of the entire Commission effort in the field.

The only limitation to the amount of information which the holder of a permit for the controlled thermonuclear category can obtain is his own willingness to spend the necessary time in reading reports, attending meetings, visiting laboratories, and talking to people.

Commissioner W. F. Libby will discuss radioisotopes in industry, manpower, and information services for the atomic industry.

Senator ANDERSON. May I have some discussion on the thermonuclear, Mr. Chairman? You stated that the Commission started research on thermonuclear reactions in 1951. Do we have any idea when either the British or the Russians started?

Mr. STRAUSS. I have no idea when the Russians started, Senator Anderson, but it would be reasonable to assume that they began even prior to that date, since you will recall that their first test of a thermonuclear weapon took place in August of 1953. The British research must have began fairly close to that date ,but we have never asked—at least, I have never asked nor heard volunteered a date upon which they began.

As a matter of fact, it is perhaps hard to decide when research on a subject as esoteric as this begins. Men start to think about it and do a little work in their laboratories. Perhaps reference to their laboratory notebooks would show. But the date which appears in this statement of 1951 is the date upon which the Commission took note of the work by beginning to appropriate to it directly.

I have no doubt that there was thinking about it and perhaps the writing of some papers and reports that even antedated 1951.

Senator ANDERSON. I think I would agree with you. I think there was quite a bit of work. This is the official date. We don't have a British official date.

Mr. STRAUSS. I do not have it. I am sure that they would supply it if we requested it. There is nothing particularly secret about that.

(Subsequently, the AEC submitted the following for the record.)

Experimental work on controlled thermonuclear processes began at Imperial College, London, in 1947 and at the Clarendon Laboratory in 1948. This work was given Government financial support in October 1948 at Imperial College and, in February 1948, at the Clarendon Labortary. The work was transferred from the universities to the AERE (Harwell) in 1951. A United Kingdom patent application was filed in the United States in April 1947 under the name of George Paget Thomson.

Senator ANDERSON. You state that the United States is pursuing a number of alternate approaches. Could you illustrate what they are and how many of them there are?

Mr. STRAUSS. They are detailed, Senator, in the part of the testimony that I skipped. But if Dr. McDaniel is here, would you let me ask Dr. McDaniel, Acting Director of the Division of Research of the Commission, to give you a brief rundown of the several approaches?

Senator ANDERSON. The only reason I ask the question is that I see nothing in here that refers to Oak Ridge. Aren't they doing something down there?

Mr. MCDANIEL. They are.

Senator ANDERSON. Is that in this category?

Mr. MCDANIEL. It is not explained in detail in that category but I understand they are preparing a paper for publication fairly soon.

Senator ANDERSON. Why was it left out?

Mr. STRAUSS. You will find it stated on page 7, that this research is carried out at Los Alamos, Oak Ridge, Princeton. They are all listed.

Senator ANDERSON. You state that during the past year there have been some very important developments in research and these developments include the achievement of true thermonuclear neutrons in the United States.

Mr. STRAUSS. Senator, we are not sure whether true thermonuclear neutrons have been achieved and it will be a number of months before we know the answer.

Senator ANDERSON. Are you sure that the people at Los Alamos do not believe that the Perhapsatron S–3 has produced true thermonuclear neutrons?

Mr. STRAUSS. I think they believe it but on the other hand they have at times in the past believed they have achieved thermonuclear neutrons. This type of confidence in one's work is essential and not an unusual attribute in men who are keen about their work. They will not, however, make the categorical statement that they have achieved true thermonuclear neutrons.

Senator ANDERSON. Are they allowed to make that categorical statement? Wouldn't they make it if they were absolutely free to do so?

Mr. STRAUSS. Senator, there is no muzzling of our people on a matter of that sort.

Senator ANDERSON. You said the people at Los Alamos do believe they have achieved true thermonuclear neutrons.

Mr. STRAUSS. Some of them.

Senator ANDERSON. I don't want to get into names, but I could name some that do. So could you. Are they not outstanding people? Why do you believe they have not achieved it?

Mr. STRAUSS. Why do I believe they have not achieved it?

Senator ANDERSON. Yes.

Mr. STRAUSS. Because they tell me that they are not positive.

Senator ANDERSON. The men that believe it strongly tell you that they don't believe it.

Mr. STRAUSS. No. We are getting into a matter of semantics.

Senator ANDERSON. Would you indicate some of the people who do believe it?

Mr. STRAUSS. By name?

Senator ANDERSON. Yes.

Mr. STRAUSS. I think that would be unfair to them Senator. You have had them testify before your committee and I was not present.

Senator ANDERSON. That is the situation I am in. I would be unfair if I named them. But we both know who they are and they are outstanding people.

Mr. STRAUSS. No; you have privileges that I do not have. I would hesitate to say what a man's beliefs are without consulting with him first. There is a group of men actively engaged in this project at the Los Alamos Laboratory and at other laboratories who feel reasonably confident but not certain that their results have to date produced thermonuclear neutrons.

But I point to the fact that they have also felt that way at times in the past and have come around to the belief that they were wrong in the past.

Senator ANDERSON. I thought at Los Alamos they found some evidence of neutrons and processed to set up tests that they were not true thermonuclear neutrons and found they were not.

Now they have set up tests again, and they believe that they are true thermonuclear neutrons.

Mr. STRAUSS. Those tests are incomplete at the present time, Senator.

Senator ANDERSON. What is the experience of our laboratories on the achievement of temperatures higher than 6,000,000°? Have they gone above that?

Mr. McDANIEL. Not substantially above.

Senator ANDERSON. 20,000,000°?

Mr. McDANIEL. No, sir.

Senator ANDERSON. Does anybody think they have gone 30,000,000°?

Mr. McDANIEL. They have not reported to me, sir.

Senator ANDERSON. What is the longest time we have been able to maintain these neutron bursts compared with the British?

Mr. McDANIEL. For 2 or 3 microseconds. The British 2 or 3 milliseconds.

Senator ANDERSON. Will you reduce that to lay language?

Mr. McDANIEL. We have maintained the burst of neutrons for two or three millionths of a second. The British have maintained the burst of neutrons for three or four thousandths of a second.

Senator ANDERSON. That is approximately a thousand times as long.

Mr. McDANIEL. Approximately.

Mr. STRAUSS. Senator, as I am sure you know, it is not only the period of containment but the degree of temperature and the density of the plasma. All three of these things must reach a certain point before this reaction occurs and can be of use.

Senator ANDERSON. I think we would all agree that we seem to have done much better than the British on density which is a very important part of it. I am just wondering what we had done about the length of it.

It is my understanding that United States industrial representatives still can't participate in the United States-United Kingdom exchange of information despite the fact that the British industry can participate.

Is that correct?

Mr. STRAUSS. No; it is not my understanding, Senator. The exchange of information between the United States and the United Kingdom occurs at governmental level and as far as I know in those exchanges—I have not attended the meetings—no private industries are present except in their role as contractors for the Government.

Senator ANDERSON. That is exactly right, as contractors for the Government. The British industry is allowed to participate; is it not?

Mr. STRAUSS. American industry is allowed to participate as a contractor. As a matter of fact, all of our research in this particular area is carried on by contract with private universities.

Senator ANDERSON. Are you positive that American contractors can participate in the United States-United Kingdom exchanges?

Mr. STRAUSS. I don't understand the question, Senator.

Senator ANDERSON. Let me see if I can frame it again, Mr. Chairman. My understanding is that in the exchanges between the United States and United Kingdom, British industry can participate as contractors and American industry cannot; is that correct?

Mr. STRAUSS. Let me refer that question to someone who attended these meetings.

Mr. FIELDS. I have not attended the meetings, Senator, but I think you are referring to the case where an independent private research and development effort is going on in this country and the desire of those involved to attend a joint United States-United Kingdom meet-

ing on the Sherwood program. We have contractors there who are doing work for the Government. Since this is on a government-to-government level, industry, where they have contracts with us, have been allowed to attend. It is a problem that we are looking at because it goes back to the terms of the bilateral. We arranged a special session following the last intergovernmental conference so that we spent 1 day reviewing with the independent contractors and access permittees the discussions and the technical work which were covered in the previous 2 days of the intergovernmental conference. It is a matter of how to arrange these intergovernmental meetings. There has been no attempt to deny them the information. It is a question of whether they can be present at the time it takes place. We are reviewing this. There is a legal problem involved here, as I understand it.

Senator ANDERSON. I think, General Fields, we would both agree that was a somewhat long answer. Let me put the question again.

Mr. FIELDS. Yes, sir; I would.

Senator ANDERSON. I understand that in the United States-United Kingdom exchange of information, British industry, as contractors, may participate, but American industry may not; is that correct?

Mr. DIAMOND. That is not correct. American contractors may participate as representatives of the Government and communicate information in accordance with the bilateral.

Mr. FIELDS. That is correct.

Chairman DURHAM. What is the reason for not declassifying all of this? Can somebody give me a reason?

Mr. STRAUSS. Are you addressing me, Mr. Chairman?

Chairman DURHAM. Yes.

Mr. STRAUSS. Because there is still the belief that a part of this deals with restricted data, and until we have determined that that is not the case, if it should not be the case, we cannot declassify it because, as you know, once an item of this sort is declassified it cannot be recaptured for purposes of security.

We have, therefore, moved slowly in declassification in order to protect restricted data.

Chairman DURHAM. You don't even know whether or not you have produced thermonuclear neutrons?

Mr. STRAUSS. I am sorry.

Chairman DURHAM. You have not identified the neutrons, according to your statement.

Mr. STRAUSS. That is true.

Chairman DURHAM. I don't see why we couldn't declassify the whole thing unless there is something in the weapons field that is involved in this.

Mr. STRAUSS. By the same token, Mr. Chairman, it might have been said that prior to the first controlled chain reaction, since no one knew that it could be done, one might have declassified the whole area of atomic energy in advance. I think you would agree with me that would have been an improvident step.

The fact that this is not yet known to be feasible is not, I believe, sufficient grounds for declassification of all the work leading to the end that one section to achieve.

Senator ANDERSON. May I come back to the answer that was given a moment ago because I am trying to find out whether that last language was designed to throw us a little bit off the track.

Mr. DIAMOND. No, sir; it was not.

Senator ANDERSON. The British people sit as representatives of their Government; don't they?

Mr. DIAMOND. I believe they do.

Senator ANDERSON. And American industry does not sit as representatives of the Government.

Mr. DIAMOND. Our contractors do.

Senator ANDERSON. Do you know whether General Dynamics has tried to get into this field and has been refused to be allowed to participate?

Mr. STRAUSS. I can answer that, Senator. General Dynamics has a contract with a Texas group for research in this field, independently of the Government.

Senator ANDERSON. And therefore independently of the Government it can't sit in the United States-United Kingdom exchanges.

Mr. STRAUSS. No; I don't believe that to be a fact?

Mr. FIELDS. Yes, sir; that is a fact.

Senator ANDERSON. Is there someone here from General Dynamics that can straighten us out on that? Is not what I just said absolutely right?

Is there someone here from General Dynamics? We can clear this up in a hurry.

Mr. FIELDS. I don't know whether General Dynamics is involved. I do know of a company that is involved. I can tell you for the record, if you wish. Let me put it this way, Senator. Where we have contractors that are engaged in work for the Government, they have attended and represented the United States Government in these exchanges. Where we have an access permittee who may be doing work of his own, with whom we do not have a contract and who is, therefore, not representing the Government on these intergovernmental exhanges, they have not been present.

We did arrange a meeting following these exchanges so that we could brief the access permittees, including those who were doing research and development entirely on their own, as to the status of development. You may ask, Why do we do this? If, every time we want to have a conference with the United Kingdom as to what is going on in this program and exchange information, we have every access permittee present, we can never have a meeting unless we have 500 people and an auditorium in which to hold it. I think that is partly the problem.

Senator ANDERSON. That may be an argument for declassification.

Mr. STRAUSS. Senator, are you under the impression that General Dynamics does not have an access permit?

Senator ANDERSON. No. I am under the impression that British industry can take part in these United States-United Kingdom exchanges. They are all somehow permitted to come. Several firms—and I am sorry I had to pull out one—have said that the opinion given by Mr. Diamond kept them out. They may have some research going on with a private group, exactly as you pointed out, and they are barred from it.

I thought. since General Dynamics is a large and well-organized company with, I think, people of very substantial knowledge, it might be interesting to know on what basis they have been excluded from the right to participate. You did exclude them, didn't you?

Mr. DIAMOND. They have been excluded from participating in government-to-government exchanges of information.

Senator ANDERSON. It took a long time to get it stated, but they have been excluded.

Mr. DIAMOND. These are not contractors of the AEC. These are access permittees.

Senator ANDERSON. I realize that. But they are American industry.

Mr. DIAMOND. That is correct.

Senator ANDERSON. I didn't say they were contractors.

Mr. DIAMOND. Under the terms of our bilateral with the United Kingdom, the only persons who communicate classified information are government representatives or contractor representatives acting for and on behalf of the respective governments in the case of government-to-government exchanges.

Senator ANDERSON. Now we have the fact that they have been excluded. Will you tell me what useful purpose it serves, in view of the fact that General Dynamics has all sorts of classified contracts. They are building submarines; they are building airplanes and doing almost everything else under the sun. What did we gain in the way of security by excluding them?

Mr. DIAMOND. This is beyond my competence. This is a question of security.

Senator ANDERSON. I would like to have the Chairman tell us what we gained nationally as far as safety is concerned by excluding them.

Mr. STRAUSS. I don't know that I can answer that without looking into the question and getting much more information than I have. One thing is clear to me. They are working for a private contractor in this field. The information that the Commission has belongs to all the people of the United States.

Senator ANDERSON. I beg your pardon.

Mr. STRAUSS. The information belongs to everybody in the United States.

Senator ANDERSON. On gas-cooled reactors?

Mr. STRAUSS. We are talking about the controlled thermonuclear.

Senator ANDERSON. Yes; I know. That is the whole point; this is trade secrets again.

Mr. STRAUSS. I cannot follow the changes in subjects.

Senator ANDERSON. All right; let me see if I can help you. You are a lot smarter man than most of the people in this room, so I don't know why it would be difficult.

Mr. STRAUSS. I will disclaim it.

Senator ANDERSON. You may disclaim it, but we all recognize it. We had a difficulty over the gas-cooled reactor. We could not make the secrets of gas-cooled reactor obtained by this country available to industry. Apparently, trade secrets are still being protected in thermonuclear activities, and that is why the question was raised. Are we still protecting the British trade secrets to the best of our ability? Is that the reason General Dynamics was excluded? If not, what was the reason?

Mr. STRAUSS. No.

Senator ANDERSON. What was the reason, then?

Mr. STRAUSS. I will have to, in this particular instance with which I am not familiar, provide you with a detailed and careful study of it. I do not wish to get into a debate about a subject, Senator, with which

I have not been personally connected, and I don't want to be in the position of giving you incorrect information. The General Counsel has attempted to answer this, and the General Manager.

Senator ANDERSON. Yes; he did. He said that General Dynamics did not have a contract with the Government.

Mr. STRAUSS. You asked, in view of the fact that they have contracts with many other subjects, it should not also extend automatically to this. I can't answer that. It is a legal question.

Senator ANDERSON. You keep on quoting on other subjects the provision of the law that it is to stress free enterprise. General Dynamics went down and joined with a Texas company and together they are putting $10 million into thermonuclear research. Therefore, because it is private enterprise, they are going to be barred. Is that right?

Mr. STRAUSS. No. Not because it is private enterprise.

Senator ANDERSON. What is the reason? Private enterprise is not a Government contract. Isn't that right, General Fields?

Mr. DIAMOND. May I say they are not barred from access to restricted in this program? I didn't say that. They are barred from the conference. They are barred from the conference. They are barred from communicating information to the United Kingdom.

Mr. FIELDS. They do have access to the information that is actually received in this exchange. They are not at the conference. This is true. It is for a technical reason.

Senator ANDERSON. We have a new answer now. The idea is to protect the British so these people don't give them any bad information. You said they are not allowed to give information to the British. How would it hurt the British? Didn't their ZETA do pretty well without General Dynamics?

Mr. DIAMOND. I am only explaining what the bilateral now explains.

Senator ANDERSON. I want you now to explain to me why it is so dangerous for General Dynamics to tell the British what is going on in this country.

Mr. DIAMOND. I didn't say it was dangerous.

Senator ANDERSON. What is the reason? You said so they couldn't communicate to the British. What would they communicate to the British?

Mr. DIAMOND. Senator Anderson, under the act, under section 144 the act speaks in terms of government-to-government communication of information. We have included our contractors in the communication of information. We have used them as our transmitting agents. This, I think, is in keeping with the spirit of section 144 as though the precise language in section 144 speaks about the Commission communicating information or the Department of Defense communicating information.

It contemplates a government-to-government exchange of information. We have in certain areas permitted contractors or industry to transmit information when this is necessary to carry out or to perform services that they are rendering to a foreign country; for example, the United Kingdom. If one of our representatives from one of the companies in the United States who did not have a contract with the Commission was engaged in doing work for a British concern, they would be able to transmit information under the bilateral in that par-

ticular area in which they are rendering services to the United Kingdom. This is the way the bilateral has been negotiated with the United Kingdom and this is what it provides for.

Senator ANDERSON. You mean you need a change in the law so that companies that start out like this group in Texas would have access?

Mr. STRAUSS. You have put you finger on that. There are many anomalies in our practice which have their root in the law.

Senator ANDERSON. Have you come to the committee and asked them to change the law?

Mr. STRAUSS. There is before the committee right now a change that would permit the authorization of individuals who are not engaged in the Government program to transmit information.

Senator ANDERSON. That is in connection with this whole general subject of giving them arms and whatever it may be that we are going to give them.

Mr. STRAUSS. This would be 144 (d) as proposed to the Joint Committee. This would have to be done by an Executive order of the President.

Senator ANDERSON. Does that clear up the whole thermonuclear?

Mr. STRAUSS. That would not exclude controlled termonuclear.

Senator ANDERSON. I am sorry I have to keep asking the question. Does that clear up the thermonuclear problem?

Mr. STRAUSS. It would assist, I believe, from a legal point of view, in making it possible for American industry to communicate information, even though it was not rendering a service at the time it was communicating this information.

Charman DURHAM. I don't believe section 144 was called to the attention of the committee when we discussed it. Under section 144, would an Executive order have to be issued by the President before private enterprise could participate in such a case as the Senator points out?

Mr. DIAMOND. I believe under section 144 (d) there would have to be an authorization from the President to permit a person to communicate information within the category set forth in (a), (b), and (c).

Chairman DURHAM. Don't you think that is a kind of clumsy way to approach the problem? Private enterprise never would get into it then, if you had to wait 3 to 5 months for an Executive order.

Mr. DIAMOND. I think you have to have considerable control when it comes to the communication of restricted data to foreign governments and to foreign representatives.

Senator ANDERSON. This is restricted data.

Mr. DIAMOND. Yes.

Senator ANDERSON. I though we had a statement a while ago that 95 percent was not.

Mr. DIAMOND. We are only talking about rstricted data. The information that is not restricted data can be transmitted. It is unclassified.

Mr. RAMEY. What does section 144 (d) provide? Could that be put in the record?

Mr. DIAMOND. I don't have it before me, Mr. Ramey.

Mr. RAMEY. That is proposed language?

Mr. DIAMOND. That is proposed language.

Mr. RAMEY. Could we have that for the record?

Mr. DIAMOND. We can supply it for the record.

(The material referred to follows:)

(d) The President may authorize any agency of the United States or person to communicate in accordance with the terms and conditions of an agreement for cooperation arranged pursuant to subsection 144 (a), (b), or (c), such restricted data as is determined to be transmissible under the agreement for cooperation involved.

Senator ANDERSON. These people down in Texas thought they did somthing that they thought was a fine thing. I thought so, too. They joined up with a very large organization that has certainly engaged a number of fine scientists.

Dr. deHoffman, whom I am well acquainted with, is with them. They are doing a great deal of work in submarines and other fields. It did seem strange that British industry could participate in these changes, but a firm as large as General Dynamics with all of its people like Mr. Dean, who has had a great deal of experience in atomic-energy work, could not participate. If it needs a change in the law, maybe it ought to be called to our attention.

Mr. STRAUSS. I brought the Texas group and General Dynamics together in this matter. Neither one of them have complained to me about the attitude that you mention.

Senator ANDERSON. I don't say they have complained to me.

Mr. STRAUSS. I produced—"produce" is too strong a word—I suggested this arrangement.

Senator ANDERSON. It was a fine thing.

Mr. STRAUSS. It was 2 years ago, and I should think they would have come to me in the first instance had they felt excluded from anything that was essential to the carrying out of the enterprise.

Mr. FIELDS. Senator, could I make one statement and then supply something for the record? I believe that the participation of the United Kingdom industry is on the same basis as American industry, and I would like to check back at the conferences and supply that information.

Senator ANDERSON. I think that would be a good idea.

Mr. FIELDS. Yes, sir.

(The information referred to follows:)

Restricted data may be transmitted to other nations only under the terms and conditions set forth in agreements for cooperation made pursuant to section 123 of the Atomic Energy Act, as amended. There are six agrements for cooperation which provide for the exchange of restricted data. Three of these have been in effect for more than 2 years. They provide for the exchange of restricted data between governments at the governmental level and permit the exchange of such data by private parties in connection with the supply of materials, equipment, and services. The extent and effectiveness of industry's participation in these arrangements are illustrated by the following examples. In the case of Canada, American industry has been able to cooperate and exchange information, including restricted data, with their Canadian counterparts and the Canadian Government in substantially all the areas of peaceful applications in which work is being done in both countries. Notable among the United States companies which have done so are General Electric, General Dynamics, Catalytic Construction, and American Machine & Foundry. Similar arrangements have been possible in the case of the United Kingdom, although industry has not chosen to make so many private arrangements of this kind in the case of the United Kingdom. An American concern, Westinghouse Electric Corp., has for more than a year been working under contract with the Belgian Government on the design and construction of a power reactor, having been authorized to communicate the necessary restricted data. There are other United States concerns which have arrangements with Belgium under which the exchange of restricted data is permitted.

Questions were raised concerning the participation of United States industry in joint United States-United Kingdom conferences in the field of controlled

thermonuclear reactions, and particularly the question was raised as to whether industry in the United Kingdom participated on a more favorable basis. Excluding visits of short duration between persons primarily concerned with the programs in the respective Governments, there have been 3 large conferences in the controlled thermonuclear field and they have been Government sponsored for the primary purpose of accomplishing government-to-government exchanges. The first was held in the United States in February 1957 and was attended by some 475 United States nationals including Government and Government-contractor employees and approximately 115 access holders representing 33 United States firms. There were 11 British representatives, 8 of which were employees of the United Kingdom Government and 3 were contractor employees. The United States access holders attended this conference as observers, but were permitted to submit written questions to the conference through a United States Government representative. The second meeting was held in Harwell, England, June 1957. Twenty-three AEC employees and AEC contractor employees attended this meeting. On the United Kingdom side, approximately 75 persons attended including those representatives of United Kingdom industry which are analagous to holders of access permits in this area in the United States. In the meeting at Harwell, the United Kingdom access holders were permitted to take part in the oral discussion; although as a matter of fact in that meeting, the discussion was carried on mainly by Government people. The most recent conference on this subject was held in Washington in February of this year. For this conference, in the case of both United States and United Kingdom, attendance was limited to representatives of the Governments and their contractors engaged in work for the Government in the controlled thermonuclear field. Even so, there was an attendance of approximately 400. Two days later the Commission held a special briefing conference at Princeton with all interested United States access permit holders to inform them of the results of the latest meeting with the United Kingdom as well as other significant events in the program.

A specific question was raised concerning participation of the General Dynamics Co. in these conferences. Representatives of General Dynamics attended the Berkeley conference as a United States access permit holder, and as such, requested the opportunity to attend the recent February conference in Washington but was not enabled to do so because this meeting was limited to Government employees and Government contractors' representatives working for the Government in the controlled thermonuclear reactions field. The exclusion of access permit holders from the February meeting was justified on the basis of the Commission's primary obligation to assure an effective exchange on the governmental level as well as legal considerations. With respect to the first consideration, the Commission would have had no valid basis of inviting one access holder without inviting all others interested in and eligible to receive data on the thermonuclear program. This would have possibly increased the attendance of the meeting to more than 500. With respect to the second consideration, the agreements for cooperation permit the exchange of information by private industry in connection with supply of materials, equipment, and services but these agreements do not provide for the communication of restricted data by private industry except when ancillary to such activity.

Mr. FIELDS. I believe their industry has similarly to be engaged in the Government program.

Senator ANDERSON. I only want to say, Mr. Chairman, that while you think that General Dynamics and the Texas group should have come first to you, I am also interested in the mute and inglorious millions that might not get your ear, that you didn't put together. I think they have some rights, too, in this matter. I happen to know a year ago we were assured that the attorney was going to work out language, or interpretations—I am sorry—to permit these people to participate. We didn't know until a short time ago that absolutely nothing had happened during that year. I would think it might be desirable to make it possible for these people to participate, not only the group that you might have joined together but others as well.

Representative PRICE. Senator, would you yield to me for a moment?

Senator ANDERSON. Yes.

Representative PRICE. Are the criteria established for those who might have access to information in this project so narrow that they could exclude responsible organizations that are in the business of building reactors but maybe military reactors rather than civilian reactors.

Mr. FIELDS. Which criteria are you referring to?

Senator ANDERSON. Access to information on thermonuclear.

Mr. PITTMAN. If the reactor they are building is a power reactor they would be eligible under criteria No. 1.

Senator ANDERSON. Is it so narrow that it would be limited to only those engaged in the construction of civilian reactors?

Mr. PITTMAN. No; I don't believe it would. Any power reactor.

Representative PRICE. Military power reactor.

Mr. PITTMAN. I would like to read the words to see.

Representative PRICE. Haven't you denied access to companies that are building military reactors?

Mr. STRAUSS. Do you know of such, Mr. Price?

Mr. PRICE. I think so but I would not want to mention them. We have had information from different companies on this subject. I would not want to put names on the record without being certain. To my own mind I have heard of such companies.

Mr. STRAUSS. It may have been before you came in, Mr. Price. I said we would supply for the record a list of all those who applied for access and a list of all those to whom access has been granted or denied and a phone confirmation of the statement which was made in response to Senator Anderson of a little while ago to the effect that it was believed that there were no pending applications except such as might have been accumulated over the last few days when the office has been unfortunately shorthanded.

(The information referred to follows:)

As of February 24, 1958, we have received applications for access to category C–20—controlled thermonuclear processes—from 233 companies or individuals. Of these, 100 have been granted, 114 denied and 19 are still pending.

In evaluating an application for access to secret restricted data, we must determine that the applicant demonstrate a need for the information before access may be granted. In those cases where an applicant requests access to C–20, he must show such need by meeting one or more of the specific criteria laid down in our published regulation (10 C. F. R. pt. 25). These criteria are:

"(i) Is directly engaged in a substantial effort to develop, design, build, or operate a fission-power reactor that is planned for construction and is making or proposes to make, a comparative evaluation of fission and controlled thermonuclear processes for production of power; or.

"(ii) Possesses qualifications demonstrating that he is capable of making a significant contribution to research and development in the controlled thermonuclear field and is directly engaged in, or proposes to engage in, a substantial study program, or a substantial research and development program, in this field; or

"(iii) Is furnishing to a permittee having access to C–20 under subdivision (i) of this subparagraph substantial financial assistance or substantial scientific, engineering, or other professional services to be used by said permittee in carrying out the activities for which said permittee received access to category C–20; or

"(iv) Is furnishing to a permittee having access to C–20 under subdivision (ii) of this subparagraph substantial financial assistance or substantial scientific, engineering, or other professional services to be used by said permittee in the study or research and development program for which said permittee received access to category C–20."

Exhibit A, attached hereto, indicates which persons or companies have qualified for access to C–20 and the criterion upon which such access was based.

Exhibit B lists the persons or companies which have not furnished sufficient information upon which we could make a finding that the applicant met one or more of the criteria. In all cases where access has not been granted, it has been due to the inability of the applicant to meet the established and published criteria.

When the information in an application does not indicate that the applicant meets the criteria, he is so informed and given an opportunity to submit further information in his behalf. If after a reasonable period—usually 1 to 2 months—no further word has been received from the applicant, his request is placed in an inactive status, but access is not formally denied. The applicant may, at any time, reopen his case by submission of additional information.

Exhibit C shows that there are 19 pending applications as of February 24, 1958, and that, with 1 exception, there has been a recent request for additional information in each case.

The case of Kaman Aircraft, which differed from all others in that the application was classified by the applicant, has been unduly delayed through a pure administrative oversight. It is now back in the proper stream and will be handled expeditiously.

With regard to the question of whether or not a company would be granted access if its justification were that it is building power reactors for the military only, certain assumptions must be made since we have not actually received such an application. If the company were directly engaged in a substantial effort to build a power reactor for the military and indicated that for its own purposes it desired to make a comparative evalution of fission and controlled thermonuclear processes for power production, it would qualify under criterion (i), and, all other things being acceptable, would be eligible for access. If the need for the information were for work under an AEC military reactor program, the company would undoubtedly be told that it could get such information under its contract and that no access permit is needed.

Exhibit A

Access Permit Holders With Access to C–20

PERMITS GRANTED UNDER CATEGORY (I)

American Machine & Foundry
Atomic Power Development Associates
The Babcock & Wilcox Co.
Baldwin-Lima-Hamilton Corp.
Commonwealth Edison Co.
Consolidated Edison Company of New York, Inc.
Consumers Public Power District
Walter Kidde Nuclear Laboratories
The Martin Co.
Nuclear Power Group, Inc.
Nuclear Development Corporation of America
Union Carbide Corp.
Vitro Corporation of America
Westinghouse Electric Corp.
Yankee Atomic Electric Co.

PERMITS GRANTED UNDER CATEGORY (II)

Aerojet-General Corp.
Aeronutronic Systems, Inc.
Allied Research Associates
ASTRA, Inc.
Armour Research Foundation
AVCO Manufacturing Corp.
Allis-Chalmers Manufacturing Co.
Robert F. Bacher
Battelle Memorial Institute
Bendix Aviation Corp.
Brooklyn College
Melville Clark, Jr.
University of Chicago-Chicago Midway Laboratories
California Research Corp.
G. C. Dewey & Co., Inc.
E. I. du Pont de Nemours
Eastern Technical Associates
Ford Motor Co.
Melvin B. Gottlieb
General Electric
General Dynamics
University of Houston
International Telephone & Telegraph Corp.
William I. Linler
Arthur D. Little, Inc.
Lockheed Aircraft Corp.
National Electronics
National Research Corp.
North American Aviation
Marion L. Pool
Radio Corporation of America
The Ramo-Wooldridge Corp.
The Rand Corp.
Raytheon Manufacturing Co.
Stanford Research Institute
Sylvania-Corning Nuclear Corp.
Sylvania Electric Products
Technical Research Group
M. Ten Bosch, Inc.
Technical Operations, Inc.
Walter H. Zinn
Zenith Radio Research Corp.

PERMITS GRANTED UNDER CATEGORY (III)

American Gas & Electric Service Corp.
Bechtel Corp.
Commonwealth Associates, Inc.
The Cleveland Electric Illuminating Co.
Central Illinois Light Co.
Illinois Power Co.
Jackson & Moreland
Kansas City Power & Light
Pacific Gas & Electric
Philadelphia Electric
Public Service Electric & Gas
Union Electric Co.

PERMITS GRANTED UNDER CATEGORY (IV)

Felix T. Adler
Leo Brewer
Hans Bethe
Manson Benedict
Subrahmanyan Chandrasekhar
B. L. Cohen
Richard Courant
Kenneth M. Case
Kenneth Downs
Freeman J. Dyson
Walter M. Elsasser
Bernard T. Feld
Eugene Greuling
Marvin L. Goldberger
George W. Hinman
Robert Karplus
Herbert Kranzer
Karl Lark-Horowitz
Julian E. Mack
Thomas H. Pigford
Milton S. Plesset
Robert D. Richtmyer
Bruno B. Rossi
James F. Schumar
Glenn T. Seaborg
Alan W. Searcy
Frederick Seitz
Albert Simon
Texas Atomic Energy Research Foundation
Technical Services, Inc.
Eugene P. Wigner
Fredrik Zachariasen
Zenith Radio Corp.

EXHIBIT B

INACTIVATED (DENIED) C–20 REQUESTS

Associated Factory Mutual Fire Insurance
Albion Malleable Iron Co.
Alexander & Alexander (insurance)
Airborne Instruments Laboratory
Air Products, Inc.
American Casualty Company of Reading
Alco Products, Inc.
Arthur Andersen & Co. (public accountants)
American Research & Development Corp. (investment)
Harold E. Anderson (engineering consultant)
Aerovox Corp. (electronic components)
Bell Aircraft
Theodore Baumeister (consultant)
David T. Barish (consultant)
George K. Brokaw (consultant)
Marion W. Boyer (consultant to Edison Electric Institute)
Willis T. Batcheller (consultant)
Combustion Engineering (equipment)
Central Mutual Insurance Co.
Curtiss-Wright Corp.
Chempump Corp. (pumps)
Chemical Construction Corp. (construction)
Clevite Corp. (components)
Consultants & Designers (designing and drafting service)
Cooperative Power, Inc.
Carolina-Virginia Nuclear Power
California Institute of Technology
Central Power & Light Co.
Community Public Service Co.
Dow Chemical
Diamond Alkali
Duke Power
Delaware Power & Light
De Laval Steam Turbine
Del Electronics (instruments)
B. W. Downs (consultant)
Daystrom, Inc. (equipment)
Ebasco Services, Inc.
Electromec Design & Development (design and drafting service)
Fairchild Camera & Instrument (instruments)
H. K. Ferguson Co. (plant design and construction)
Farrand Optical Co.
Factory Mutual Rating Bureau
Franklin Institute of State of Pennsylvania
Gurinsky, David H. (consultant)
Grant, N. J. (consultant)
B. F. Goodrich
The Garrett Corp. (equipment)
Gust & Irish (patent lawyer)
Grumman Aircraft
The Home Insurance Co.
Hughes Aircraft
Hagan Corp. (instruments and chemicals)

EXHIBIT B—Continued

High Voltage Engineering Corp. (equipment)
Haseltine, Lake & Co. (patent lawyers)
Internuclear Co. (consultants)
Isbrandtsen Co. (shipowners)
Isler, Martin (patent drawings)
Koppers Co.
Kenyon & Kenyon (patent lawyers)
Koven Fabricators (steel fabrication)
Leeds & Northrup (instruments)
Little, Robert N. (professor, University of Texas and consultant)
Long, Frederick F. (consultant)
Lithium Corporation of America
Monsanto Chemical
Michigan Chemical
McMillan, S. Sterling (Western Reserve University)
Minnesota Mining & Manufacturing
Maryland Casualty Co.
Madsen, Stanly W. (Shieldalloy)
Department of Public Health, Massachusetts
Metals Research & Development (laboratory)
Mackintosh, Alexander (architect, engineer)
Marquardt Aircraft Co.
Municipal Light & Power, Pasadena
Neutronics Laboratory (instruments)
New Jersey Power & Light
North Carolina State College
Northrop Aircraft
Neodyne Corporation
Nuclear Materials and Equipment
K. D. Nichols (consultant)
Oklahoma Gas & Electric
University of Oklahoma Research Institute
Phillips Petroleum
Pickard, Warren, Lowe Associates
Pacific Power & Light
Pereira & Luckman (architect, engineers)
P. E. C. Corp.
Pennsylvania Department of Health
Radiation Applications, Inc. (consultants)
Reynolds, Thomas (consultant)
Renwar, Inc. (writing service)
Rensselaer Polytechnic Institute
Simon, Herbert (consultant)
E. H. Smith & Co. (consultants)
Stone & Webster Engineering
Shreve, Walker & Associates (architects and engineers)
Southern California Edison Co.
Shell Development Co.
Sprague Electric Co.
James E. Scurlock (consultant)
Henry D. Smyth (consultant to Edison Electric Institute)
Spensley & Horn (patent lawyers)
The Stearns-Roger Manufacturing Co.
Thompson Products (equipment)
Tuck, James L. (consultant to General Dynamics)
The Texas Co.
Texas Power & Light
United Constructors & Engineers
Ray E. Untereiner
Wolverine Electric Cooperative
Weil, George L. (consultant)

EXHIBIT C

APPLICATIONS PENDING AS OF FEBRUARY 24, 1958

Date of our last letter requiring additional information

Name of applicant:	
William M. Brobeck & Associates	Feb. 19, 1958
Douglas Aircraft	Jan. 22, 1958
Gilbert Associates	Dec. 2, 1957
Giannini Research Corp	Jan. 10, 1958
Elmore A. Hale	Jan. 16, 1958
Jackson & Berueffy	Feb. 11, 1958
Kaman Aircraft	
James L. Meem, Jr	Jan. 10, 1958
Power Reactor Development Co	Jan. 16, 1958
Pioneer Service & Engineering Co	Jan. 31, 1958
Republic Aviation Corp	Jan. 10, 1958
John C. Stuart	Do.
Standard Ore & Alloys Corp	Jan. 16, 1958
The Toledo Edison Co	Jan. 21, 1958
Baltimore Gas & Electric	Feb. 24, 1958
Holmes & Narver	Feb. 13, 1958
Robert LeBaron (application received)	Feb. 15, 1958
United Aircraft Corp. (application received)	Feb. 18, 1958
Whipple, George	Feb. 19, 1958

Representative PRICE. Many applications come in informally to determine whether they would be eligible for access. When they find out that they may have difficulty they do not make a formal application. This would be more a matter of policy.

Couldn't you state whether or not the limitations are so narrow and the criteria are so narrow that a company working under a military contract might be barred from access to such information?

Mr. STRAUSS. We will answer that specific question.

Senator ANDERSON. On the bottom of page 8 you speak of the fact that the Commission has approved the construction of a complex of laboratories and one of those is at Princeton.

Last week Dr. Ruark stated that the Commission may have to request additional funds for Project Sherwood if the program is to go forward vigorously. I think there was a statement that this might be in operation during fiscal year 1959 if you got some additional funds. Is the Commission planning to request more funds than that contained in the fiscal year 1959 budget?

Mr. STRAUSS. Senator, the answer to that is that we are in a series of continuing discussions with the Bureau of the Budget and I believe that there is a Federal regulation that would make it difficult for me to be responsive until we are in a position to state what the budget will permit us.

Senator ANDERSON. No, Mr. Chairman, I am quite sure what the budget requirement is: I think you can't testify to the need unless you are asked by a member of the committee to testify and then I believe you are released from your obligation.

Is that not correct?

Mr. STRAUSS. I am sure you know far more about it than I do. I am under the impression that I could not testify on the subject of budget or requirements at this stage of the conversation. I would like to get some counsel on it.

Senator ANDERSON. I only want to say that I was on the other side of the desk at one time and my attorney advised me, and the Attorney General advised me, that I could not go up and ask for more money but if a member asked me about my need for more money, I had a right to talk about it.

Mr. STRAUSS. I don't know whether there is any change in the intervening years. I don't want to be unresponsive to that question.

As a matter of fact, I would like very much to be responsive. Perhaps on another occasion you will permit me to be.

Senator ANDERSON. I think the Secretary of Defense spoke out just last week. I wish you would look it up because I think you can. It seemed to me at one time that the Atomic Energy Commission came in and asked for $9.1 million to speed up Project Rover that had not been approved by the Bureau of the Budget. It was done at our request. We asked the Commission to testify. The Commission did testify. I thought it was excellent testimony. We asked for the money and the Commission obtained it. I know it was not in the budget. Otherwise a congressional committee would never have any chance. I think I should have said the Secretary of Army rather than the Secretary of Defense.

Mr. STRAUSS. I might say we are very happy with the fact and proud of the fact that our research budget has been approved as an increase each year in the last several years.

The Joint Committee has been of great assistance in helping us with the Approporiation Committees. It is entirely possible that despite that we will ask for more money. I would like not to testify to that at this time.

Senator ANDERSON. Dr. Ruark was quoted as saying that additional funds would make it possible to complete this work on the model C stellerator at Princeton in 1959 instead of 1960. Without testifying on the need for money would you feel that would be a good result?

Mr. STRAUSS. I am sure you know, Senator, that this is a project in which I am personally very deeply interested and nothing I could do would be stinted—and this is true of the Commission generally—to obtain for this particular piece of research all the money that it can reasonably and usefully employ.

Senator ANDERSON. The present staff of the Project Sherwood consists of only a few individuals.

Mr. STRAUSS. There are nearly 500 people engaged in it at the present time, if my recollection is accurate, of whom nearly half are professional. That is to say, scientists and engineers, which is more than a tenfold increase since 1953.

Senator ANDERSON. I was thinking of the AEC staff in Washington. I think you have Dr. Ruark and a few people. Dr. Ruark is in a temporary capacity. He is on a 2-year leave from the University of Alabama. I think he is a fine man and without any reflection on his ability, isn't that a field where we might seek to have somebody on a permanent basis?

Mr. STRAUSS. I think it is our policy, and I believe it a good one, Senator, that in the field of science these men want to get back and ought to get back to their laboratories after a period of administrative work. They lost touch with those who have their hands dirty and there should be a rotation in that particular billet, that is the research billet, probably more than any other part of our activity. Would you agree with that, Dr. Libby?

Dr. LIBBY. I certainly would completely and I think it applies to other parts of the Government, too. The possibility of a scientist maintaining his competence while working as an administrator is rather limited. The task of keeping current is so great that it is nearly impossible to discharge administrative responsibility and read all the scientific literature and go to scientific meetings and hold scientific discussions that are necessary in order to know which are the important current issues and who the good new young men are, and these are the two vital matters that an administrator of scientific subjects in Washington must have fully in hand.

Senator ANDERSON. Mr. Chairman, in some explanation of the questions I raised about access, there is a letter in our files to Mr. Durham dated January 17, 1957, which states that as of December 31, 1956, in request for access to this controlled thermonuclear material that 74 permits had been issued and 126 had been refused.

Mr. DIAMOND. I believe the regulations of that have been amended since the time that letter was written, Senator, and our criteria have been changed so as to permit more individuals to have access to this information.

Senator ANDERSON. But you would have to admit that when 74 were granted and 126 refused that it was not completely declassified and the easiest thing in the world to get at.

Mr. DIAMOND. There was less information declassified at that time, that is correct.

Mr. STRAUSS. Senator, I would call your attention to the fact that the major declassification took place last fall. Work is still going on at as rapid a rate as possible to mark these documents accordingly.

The dates to which you have just referred in these letters refer to a period that antedates this declassification by nearly a year.

Senator ANDERSON. Yes. I referred to the fact the other day in the hearings that when the meeting was held out in Denver in June 1952 to decide whether there would or would not be classification of this whole subject, there was a vote taken among the scientists present.

Dr. Johnson was in charge of it. I gave the figures accurately the other day and I hope I get them as accurately today.

It was either that there were 98 present and 97 voted to declassify from the very beginning and 1 voted to classify.

It was classified by the Commission. That was, I believe, prior to the time that you again resumed the chairmanship of the Commission. So what I have just said is not critical of people now on the Commission. I think it was unfortunate that the whole project was not declassified in the very beginning.

I am in the hope that we could speed things in that general direction.

Mr. STRAUSS. You know, Senator, without any reflection on the caliber and earnestness of our scientific advisers that the Commission and the Government have not always followed the majority point of view. Had it done so, from the weapons point of view we would be in a very serious disadvantage today with our Soviet competition.

Senator ANDERSON. Yes. But a vote of 97 to 1 is a pretty sizable vote.

Mr. STRAUSS. Percentagewise——

Senator ANDERSON. The declassification expert for the Atomic Energy Commission was one of the people present.

Mr. STRAUSS. It is about the percentage, not quite, on the matter of going ahead with a thermonuclear weapon which was, as I recollect, 8 nays and 1 not voting.

Senator ANDERSON. I do not want to do the classification expert from the Commission any injustice, but he was one of the first to vote for declassification and he is no longer with the Commission.

Representative PRICE. Mr. Chairman, I wonder if you could give us an idea numerically what is the backlog of declassified documents in this project.

Dr. MCDANIEL. It is rather substantial. I do not have an idea of the number.

Representative PRICE. Could you hazard a figure?

Dr. MCDANIEL. I would hesitate to even hazard a guess as to the number.

Representative PRICE. How many months of work would it take to declassify all of the documents that are being worked over now?

Dr. MCDANIEL. I would not hazard a guess.

Representative PRICE. Would it be a month or 6 months?

Dr. MCDANIEL. It is in this ball park.

Representative PRICE. Would it be a year?

Dr. MCDANIEL. No.

Representative PRICE. About 6 months?

Mr. STRAUSS. Mr. Price, you will take that as a very informal estimate.

Mr. FIELDS. This is Mr. Marshall, Chief of the Classification Division.

Mr. MARSHALL. Mr. Chairman, most of the reports in this field have not been prepared or even submitted for review since the time that the change in the classification rules took place. As to the numbers of documents that have been so far declassified, I can say this: Every one that has been submitted to us has been declassified. The numbers are less than 100 so far. Time has been very short.

Representative PRICE. What is the backlog that we have been talking about, about papers that are declassifiable but are not yet declassified?

Mr. MARSHALL. The numbers of papers that exist on a classified basis that would be considered suitable for review by their authors is still small. I do not know the exact number. It probably numbers something in the neighborhood of a couple of hundred, but do not hold me to this, please. I do not know. The number is still so small because the reports have not been prepared for this purpose yet.

Representative PRICE. Would you give us a statement for the record, Mr. Chairman, on this point?

Mr. STRAUSS. We will do so.

(The information referred to follows:)

There are approximately 130 reports on the controlled thermonuclear reactor program suitable for publication, but not yet declassified.

Representative PRICE. Do you believe we have reached the stage in the development and research program where a general scale-up of our physical devices is desirable? This is with reference to the thermonuclear program.

Mr. STRAUSS. It is my impression that that is the belief of some of the laboratories with respect to the devices that they are working on. But there I would like to ask Dr. McDaniel if he would be more specific.

Dr. MCDANIEL. Yes. Our Steering Committee has been reviewing with the scientists recently the idea of expanding their programs to larger instruments and are currently studying two proposals for such.

Representative PRICE. Has the British experience with their Zeta machine been helpful in this program?

Dr. MCDANIEL. It has been helpful.

Chairman DURHAM. Are there any further questions?

Senator ANDERSON. Mr. Chairman, in the original draft that you sent up, from which we decided to leave out the power discussion in detail, there were a number of figures used as to the number of reactors and plants building, and so forth. In order that we might have a chance to study that before you come up again, could you submit the lists? I think they are in the material submitted in the annual report.

Mr. STRAUSS. They are in the annual report. I do not have a copy of that draft. When the arrangement was made to drop those things out, this was remimeographed and does not appear.

Mr. FIELDS. You are talking about backup material to illustrate how we arrived at certain figures. I think we could supply this.

Senator ANDERSON. That is absolutely correct. On page 5 in the old draft you refer to number paragraph (b) and (c) and I would like to have the background for the numbers.

(The language in the draft referred to is as follows:)

(*b*) This industry, according to figures recently announced by its spokesmen, had built or had under construction in 1957 a total of 75 reactors of which 42 are for civilian use or for military propulsion and power. The power reactors are for private industry, for the Government, or for the foreign market. In addition to the 75 reactors built or building, the industry spokesmen announced that orders are on hand for 10 others, including 5 power producers.

(*c*) AEC records indicate that as of December 31, 1957, we had built and operated 23 reactors in the United States for the production of power, civilian and military. They include reactors for the production of electricity and for propulsion and reactor experiments leading to such applications. Another 45 are under construction and 20 are under development or in the planning stage. This total of 88 power reactors represents a program which, to our knowledge, is not approached by any other country, either in performance or planning.

Mr. STRAUSS. If I am not mistaken, this is the material which is to be found in those pages which I asked to be incorporated in the transcript and which are incorporated by reference. Pages 77 to 125 of the 23d semiannual report.

Senator ANDERSON. They are also in the appendix, in the back part of it.

Mr. STRAUSS. That is right, sir.

Senator ANDERSON. I would like very much to have the information that ties back directly to the statement.

Mr. STRAUSS. We will key those figures in the statement to the data in the semiannual report to save you any difficulty in checking them.

(The material referred to follows:)

1. "Six power reactors representing five different civilian power concepts went into operation during the year [1957]."

SOURCE

Reactor:	*Concept*
1. Shippingport atomic power station 2. Army package power reactor No. 1	1. Pressurized water
3. Sodium reactor experiment	2. Sodium graphite.
4. Vallecitos boiling-water reactor	3. Boiling water.
5. Homogeneous reactor experiment No. 2	4. Aqueous homogeneous.
6. Organic moderated reactor experiment	5. Organic moderated.

2. "This [atomic energy] industry, according to figures recently announced by its spokesmen, had built or had under construction in 1957 a total of 75 reactors * * *"

SOURCE

January 1, 1958, press release by Atomic Industrial Forum. In the forum's final publication entitled "The Atomic Industry, 1957" this figure was revised to 73.

3. "Orders are on hand for 10 others [reactors], including 5 power producers."

SOURCE

Atomic Industrial Forum's January 1, press release. This phraseology should have followed more closely the forum's actual statement that "* * * during the year industry also received contracts for the construction of 10 additional reactors." (This was revised to eight in the forum's final publication.) The number of orders on hand total far more than 10 reactors.

4. "AEC records indicate that as of December 31, 1957, we had built and operated 23[1] reactors in the United States * * *."

SOURCE

1. Vallecitos boiling-water reactor.
2. Shippingport atomic power station.
3. Boiling reactor experiment No. 1 (Borax–1).
4. Boiling reactor experiment No. 2 (Borax–2).[2]
5. Boiling reactor experiment No. 3 (Borax–3).[2]
6. Boiling reactor experiment No. 4 (Borax–4).[2]
7. Los Alamos fast breeder (Clementine).[3]
8. Homogeneous reactor experiment No. 1 (HRE–1).
9. Homogeneous reactor experiment No. 2 (HRE–2).
10. Experimental breeder reactor No. 1 (EBR–1).
11. Experimental boiling-water reactor (EBWR).
12. Sodium reactor experiment (SRE).
13. Organic moderated reactor experiment (OMRE).
14. Los Alamos power reactor experiment No. 1 (LAPRE–1).[4]
15. Naval reactor facility (*Nautilus* prototype).
16. U. S. S. *Nautilus*.
17. U. S. S. *Skate*.
18. Submarine intermediate reactor (*Seawolf* prototype).
19. U. S. S. *Seawolf*.
20. Heat transfer reactor experiment No. 1 (HTRE–1).
21. Aircraft reactor experiment (ARE).
22. Army package power reactor No. 1 (APPR–1).
23. Classified reactor in ANP program.

5. "Another 45[5] [power reactors and reactor experiments] are under construction."

SOURCE

1. Commonwealth Edison Co. Dresden Station.
2. Consolidated Edison thorium reactor.
3. Power Reactor Development Co., Enrico Fermi plant.
4. Yankee Atomic Electric Co. plant.
5. NS. *Savannah*.
6. Los Alamos power reactor experiment No. 2 (LAPRE–2).
7. Los Alamos molten plutonium reactor experiment No. 1 (LAMPRE–1).[6]
8. Experimental breeder reactor No. 2 (EBR–2).
9. Army package power reactor No. 1a (APPR–1a).
10. Gas-cooled reactor experiment (GCRE).

---

[1] This number is consistent with the tabulation on p. 356 of the semiannual report. It was derived there by totaling the 1st 2 entries on the line "Total, power producing reactors" which are:

Operated, later dismantled	9
Operated	14
Total	23

[2] Borax-2, 3, and 4 were all built in the same structure, used much of the same equipment, and were essentially successive modifications of the same reactor. Because the modifications permitted new types of experiments (Borax-3 added a turbine generator, Borax-4 introduced uranium oxide fuel elements), Argonne National Laboratory has designated them as separate experiments.

[3] Clementine has been included in our records as a power reactor experiment since it was conceived of at the time as contributing to power reactor development. Moreover, it did permit study of the control of fast reactors and on a limited basis the study of power production principles. It differed from our present conception of a power reactor experiment in that it was designed primarily to provide a high-intensity source of neutron for physics studies rather than to test the many interrelated factors effecting the design of a full-scale power reactor, such as fuel, moderator, coolant, mechanical components, structural materials, etc.

[4] LAPRE–1 was designed as a small reactor experiment which was to produce 2,000 kilowatts of heat power. It operated only very briefly and never succeeded in reaching full power.

[5] The tabulation on p. 356 of the semiannual report shows, on the line "Total, power producing reactor," 46, rather than 45, reactors as "being built." The difference of one is accounted for by the fact that the Argonne boiling reactor facility (ARBOF) is erroneously carried in the semiannual report as "being built." Design is, however, well along.

[6] It is now believed that considerably more technical investigation, development, and evaluation are required before a power reactor experiment can be built embodying this concept.

11. Argonne low-power reactor (ALPR).
12. Submarine advanced reactor prototype.
13. Small submarine reactor prototype.
14–15. Large ship reactor prototype (two reactors).
16–17. Guided-missile cruiser *Long Beach* (two reactors).
18–25. Aircraft carrier (eight reactors).
26–42. Seventeen reactors for sixteen submarines.
43–44. Two classified reactors in ANP program.
45. Belgium (Syndicat'd Etude de l' Energie Nucleaire—SEEN).

6. "* * * and 20[7] [power reactors and power reactor experiments] are under development or in the planning stage."

SOURCE

1. Rural Cooperative Power Association.
2. Wolverine Electric Cooperative.[8]
3. Consumers Public Power District.
4. Chugach Electric Association, Inc.
5. Northern States Power Co.
6. Pennsylvania Power & Light Co.
7. Carolinas-Virginia Nuclear Power Associates, Inc.
8. East Central and Florida Nuclear Power Associates, Inc.
9. Gas-cooled power reactor.[9]
10. Large scale heavy water reactor.[10]
11. City of Piqua, Ohio.
12. Maritime gas-cooled reactor.
13. Italy (Edisonvolta).
14. Italy (Societa Italiana Meridionale Energia Atomica).[11]
15. Brazil (American & Foreign Power Co.).[12]
16. Cuba (American & Foreign Power Co.).[12]
17. Mexico (American & Foreign Power Co.).[12]
18. Argonne boiling reactor facility (ARBOR).
19. Liquid metal fuel reactor experiment (LMFRE).
20. Destroyer reactor prototype.

NOTE.—The above listing relates to number mentioned in the chairman's statement. A current listing should add the Pacific Gas & Electric Co. project which was announced after the statement was submitted.

7. "This total of 88 power reactors represents a program which, to our knowledge, is not approached by any other country, either in performance or planning."

SOURCE

This number appears in the tabulation on page 356 of the semiannual report opposite the item, "Total, power producing reactors" under the "Total" column. It represents the total of the following figures given previously in this statement.

Item No. and category:	*Number*
4. Built and operated	23
5. Under construction	45
6. Under development or planned	20
Total	88

[7] The tabulation on p. 356 of the semiannual report, on the line "Total, power producing reactors," shows 19 as "planned." The difference of one is again accounted for by the fact that the semiannual erroneously carries ARBOR as "being built" rather than as "planned."

[8] Tentative pending outcome of cost analyses being undertaken at Oak Ridge National Laboratory.

[9] Design study only, as authorized by Public Law 85–162.

[10] This is the reactor mentioned in the third invitation under the power demonstration reactor program, but no specific plans have yet been formulated either by Government or industry.

[11] Based on information received since the semiannual report was issued, it is now believed that this project is unlikely to materialize.

[12] These projects have been deferred indefinitely because of increases in costs.

8. "Six [13] atomic reactors designed to produce electricity came into operation across the United States in 1957. One is full scale; the others are smaller experimental plants * * *."

SOURCE

1. Shippingport atomic power station.
2. Vallecitos boiling-water reactor.
3. Sodium reactor experiment (SRE).
4. Army package power reactor No. 1 (APPR–1).
5. Homogeneous reactor experiment No. 2 (HRE–2).[14]

9. "Including it [EBWR], five reactors are presently delivering electricity. They have a total capacity of about 85,000 [15] kilowatts."

SOURCE

Reactor	Electrical kilowatts (design rating)	
	Net	Gross
1. Shippingport atomic power station	60,000	[1] 68,000
2. Vallecitos boiling-water reactor	5,000	[2] 5,200
3. Experimental boiling-water reactor (EBWR)	4,500	[3] 5,000
4. Sodium reactor experiment (SRE)	[4] 6,000	[4] 6,500
5. Army package power reactor No. 1 (APPR–1)	1,855	2,085
Total	77,355	86,785

[1] The Shippingport station is provided with a turbogenerator rated at 100,000 electrical kilowatts and may reach this gross output with later cores.
[2] It is believed that the Vallecitos plant could exceed this output substantially if not limited by turbine-generator capacity.
[3] The turbine attached to EBWR has operated at 6,250 gross electric kilowatts. The reactor itself has produced 50,000 thermal kilowatts, which would permit a much higher electrical output if turbine-generator capacity were available.
[4] This, as heading indicates, is design rating. Maximum output to date has been 2,000 net electrical kilowatts. Other reactors listed have reached the full design ratings shown.

10. "In addition to the plants built or building, contracts have been negotiated or planning has started for another 12 [16] full-scale plants of various types and sizes to be completed by the mid-1960's."

---

[13] This statement was erroneous. There were only 5 reactors designed to produce electricity which came into operation in 1957 as listed above. The organic moderated reactor experiment also came into operation in 1957 but it was not designed to produce electricity.
[14] Because it is provided with a very small turbine generator, the HRE–2 will produce only token amounts of electricity (about 300 kilowatts gross) as compared to a thermal output of 5,000 kilowatts, most of which will be dumped to the atmosphere.
[15] This total of 85,000 electrical kilowatts represents designed gross capacity as shown above.
[16] The tabulation on p. 356 of the semiannual report, on line A1, "Full-scale civilian power reactors, United States locations, also shows 12 reactors under 'Planned.'" Since the report was issued, the Pacific Gas & Electric Co. project has been added, raising the total to 13.

SOURCE

1. Rural Cooperative Power Association.
2. Wolverine Electric Cooperative.[17]
3. Consumers Public Power District.
4. Chugach Electric Association, Inc.
5. East central and Florida west-coast nuclear groups.
6. Northern States Power Co.
7. Pennsylvania Power & Light Co.
8. Carolinas-Virginia Nuclear Power Associates, Inc.
9. City of Piqua, Ohio.
10. Maritime gas-cooled reactor (MGCR).[18]
11. Gas-cooled power reactors.[19]
12. Large-scale heavy-water reactor.[20]

11. "An additional three civilian power reactor experiments are being built and two others are planned." [21]

SOURCE

A. Civilian power reactor experiments being built:
   1. Experimental breeder reactor No. 2 (EBR–2).
   2. Los Alamos power reactor experiment No. 2 (LAPRE–2).
   3. Los Alamos molten plutonium reactor experiment No. 1 (LAMPRE–1).[22]
B. Civilian power reactor experiments planned:
   1. Argonne boiling reactor facility (ARBOR).
   2. Liquid metal fuel reactor (LMFRE).

12. "Thus, the nuclear powerplants for civilian use already in operation in the United States, under construction or planned by industry number 30 [23] with an aggregate planned capacity of about 1,300,000 kilowatts." [24]

---

[17] Tentative pending outcome of cost analyses being undertaken at Oak Ridge National Laboratory.

[18] Contract for development work leading to a prototype reactor is currently under negotiation.

[19] Design study only, as authorized by Public Law 85–162.

[20] This is the reactor mentioned in third invitation under power demonstration reactor program, but no specific plans have yet been formulated either by Government or industry.

[21] The tabulation on p. 356 of the semiannual report, opposite line A3, "Civilian power reactor experiments," shows 4 reactors under "Being Built" and 1 under "Planned." The difference is due to the fact that the semiannual report erroneously carried the ARBOR project as "being built" instead of as "planned."

[22] It is now believed that considerably more technical investigation, development, and evaluation must be undertaken before a reactor experiment can be built embodying this concept.

[23] This is reconciled with the tabulation on p. 356 of the semiannual report, as follows:

Line A1. "Full-scale civilian power reactors, United States locations," under "Total" shows	19
Line A3. "Civilian power reactor experiments," under "Total" shows	17
Subtotal	36
Less line A3 under "Dismantled"	6
Remainder	30

[24] Capacity figures are based on the best available information. In some cases future modification in plans may cause changes in the figures. As indicated in other footnotes to table below, total capacity includes about 138,000 electrical kilowatts of conventional superheat.

SOURCE

Plant	Electrical kilowatts	
	Gross	Net
1. Shippingport atomic power station	[1] 68,000	[1] 60,000
2. Vallecitos boiling-water reactor	5,200	5,000
3. Commonwealth Edison Co., Dresden station	192,000	180,000
4. Consolidated Edison thorium reactor	[2] 275,000	255,000
5. Power Reactor Development Co., Enrico Fermi plant	[3] 100,000	[3] 90,000
6. Yankee Atomic Electric Co	146,000	134,000
7. NS. *Savannah*	17,400	14,900
8. Rural Cooperative Power Association	[4] 24,000	22,000
9. Wolverine Electric Cooperative [5]	[6] 10,000	9,560
10. Consumers Public Power District	8,800	75,000
11. Chugach Electric Association, Inc	10,800	10,000
12. East central and Florida west-coast nuclear groups	57,100	46,000
13. Northern States Power Co	[7] 66,000	62,000
14. Pennsylvania Power & Light Co	[8] 155,000	150,000
15. Carolinas-Virginia Nuclear Power Associates, Inc	18,850	16,950
16. Large-scale heavy-water reactor [9]	110,000	110,000
17. City of Piqua, Ohio	12,500	11,400
18. Maritime gas-cooled reactor	[10] 45,000	[10] 15,000
19. Gas-cooled power reactor [11]	64,000	55,000
20. Experimental breeder reactor No. 1 (EBR-1)	200	[12]
21. Experimental breeder reactor No. 2 (EBR-2)	20,000	16,500
22. Experimental boiling-water reactor (EBWR)	5,000	4,500
23. Boiling reactor experiment No. 4 (Borax-4)	2,300	2,000
24. Argonne boiling-reactor facility (ARBOR)		
25. Sodium reactor experiment (SRE)	6,500	6,000
26. Organic moderated reactor experiment (OMRE)		
27. Homogeneous reactor experiment No. 2 (HRE-2)	300	[12]
28. Liquid metal fuel reactor experiment (IMFRE)		
29. Los Alamos power reactor experiment No. 2 (LAPRE-2) [13]		
30. Los Alamos molten plutonium reactor experiment No. 1 (LAMPRE-1) [13]		
Total	[14] 1,491,950	[14] 1,340,810

[1] The Shippingport station is provided with a turbogenerator rated at 100,000 electrical kilowatts and may reach this gross output with later cores.
[2] Includes 112,000 electrical kilowatts of conventional superheat.
[3] The Enrico Fermi reactor is to be provided with a turbogenerator rated at 150,000 electrical kilowatts and may reach this gross output with later cores.
[4] Includes about 7,000 electrical kilowatts of conventional superheat.
[5] Tentative pending outcome of cost analyses being undertaken at Oak Ridge National Laboratory.
[6] Includes about 3,000 electrical kilowatts of conventional superheat.
[7] Includes about 16,000 electrical kilowatts of superheat, probably conventional, although nuclear superheat has also been con idered.
[8] Pennsylvania Power & Light may build 70,000 electrical-kilowatt plant instead.
[9] This is the reactor mentioned in the 3d-round invitation under the power reactor demonstration program, but no specific plans have been formulated either by Government or industry.
[10] The large difference between gross and net output in the case of the maritime gas-cooled reactor is due to power which would be absorbed by the gas compressors.
[11] Design study only authorized by Public Law 85-162.
[12] Negligible.
[13] It is now believed that considerably more technical investigation, development, and evaluation are required before a reactor experiment can be constructed embodying this concept.
[14] Since semiannual report was issued, Pacific Gas & Electric Co. project has been announced, 50,000 electrical kilowatts gross; 47,500 electrical kilowatts net.

13. "Three of these plants (nuclear powerplants for civilian use) are being financed entirely by private capital * * *." [25]

SOURCE

1. **Vallecitos boiling-water reactor.**
2. **Commonwealth Edison, Dresden station.**
3. **Consolidated Edison thorium reactor.**

14. "The four [26] **large plants now under construction * * *."**

[25] Since this statement was submitted, a fourth entirely privately financed plant has been announced, to be built by Pacific Gas & Electric Co.
[26] In the tabulation on p. 356 of the semiannual report, five "full-scale civilian power reactors, United States locations" are shown as "being built." The fifth one, not listed above, is the reactor for the NS. *Savannah*.

SOURCE

1. Commonwealth Edison Co., Dresden station.
2. Consolidated Edison thorium reactor.
3. Yankee Atomic Electric Co., plant.
4. Power Reactor Development Co., Enrico Fermi plant.

15. "Of the 6 nuclear powerplants which went into operation last year, 4[27] involved investment of the funds of private industry estimated to total about $30 million."

SOURCE

	Million
1. Shippingport atomic power station:	
Duquense contribution to reactor	$5.0
Duquesne for nonnuclear part	17.5
Westinghouse contribution	.5
Total	23.0
2. Sodium reactor experiment:	
Southern California Edison for turbine generators	1.4
North American Aviation share	2.85
Total	4.25
3. Vallecitos boiling-water reactor:	
General Electric for reactor	2.5
Pacific Gas & Electric for turbine generator	.6
Total	3.1
Grand total	30.35

16. "By the end of 1957, they [American manufacturers] had put into operation, were building, or had on order 23 machines [research reactors] in 15 nations * * *."

SOURCE

Table B2, p. 361, 23d semiannual report. It should be noted that the Switzerland (Geneva Conference) reactor was built by ORNL and is not a commercial project.

Senator ANDERSON. We all get busy and I could not quite correlate them. Thank you.

Representative PRICE. Mr. Chairman, before we leave the discussion of the thermonuclear program, I think I would like to ask a few more questions.

The Research and Development Subcommittee, in its hearings, developed a point that Senator Anderson brought out a moment ago about this vote among the scientists actually working in the Sherwood project who voted 97 to 1 for a greater declassification of the program. As a matter of fact, one of the witnesses said at that time if a vote were taken now, it would be unanimous. There would not be one dissenting vote. Has a failure to get into declassification more quickly caused any morale problems within the laboratories?

Mr. STRAUSS. I think my answer to that question is one which should be checked with the laboratories. First let me say this, Mr. Price: That a vote among the scientists as to whether or not the matter should be fully declassified is a vote by those who do not have the responsibility for protecting restricted data. That responsibility is upon the Commission.

[27] This was an error. This should have read 3 rather than 4. However, the amount of funds listed is accurate.

Representative PRICE. This was a poll by the scientists themselves.

Mr. STRAUSS. There was a poll taken very informally in the course of a press conference, I think, early in January in my office, at which I was not present. I had left before the poll was taken. There were two votes among the scientists present who said that the project had suffered by classification.

All the rest who were present said it had not. One of those two men was a man in our own employ quite recently, and the other was a director of a project—this is not said in disparagement; I mean his experience was not extensive in our work—the other was the vote on the part of a scientist active in the project who had, however, felt that he had been misunderstood by those present and who wrote me a letter afterwards qualifying his vote.

I doubt—in fact, I do not believe—that the morale has been affected in the laboratories. At one time when the question of classification was discussed with laboratory directors, the belief was expressed by at least one very competent scientist that declassification would result in such a sudden influx of individuals desiring to learn that for a period of some time—he figured up to 2 years—there would be very little time for any original work. This was, of course, an expression of opinion and he would not like to be quoted on it and I shall not give his name.

Representative PRICE. Your reference to the one who was recently with the project causes me to ask this question.

Have any of the leading scientists engaged in this work withdrawn from the project because of a strong feeling on matters of declassification?

Mr. STRAUSS. To my knowledge, none. As a matter of fact, none of the dire predictions of people leaving this enterprise or any part of our enterprise for reasons of classification or work on weapons being distasteful have I ever been able to pin down to a specific case. There must be some specific cases, but I have not been able to find them.

Representative PRICE As the declassification process goes on is there immediate publication or quick publication of papers on the various subjects?

Mr. STRAUSS. I presume, Mr. Price, that depends more or less upon the subject and whether or not publication or the announcement that it is available suffice. One does not want to go to the expense of publishing lengthy documents which will have a very limited demand. Those who are in this field receive abstracts. These abstracts inform them as to the subject covered by the declassified paper and its availability, and then they can apply for it. Sometimes the publications take the shape of a photo-offset or a mimeographed copy. They are not necessarily printed and published.

Representative PRICE. There is not any regular form of publication of the declassified papers?

Mr. STRAUSS. Let me ask Mr. Salisbury for a detailed answer to that question.

Mr. SALISBURY. Would you repeat the question?

Representative PRICE. Is there any regular form of publication of the declassified publications?

Mr. SALISBURY. There is no single regular form. There are several regular series in which they appear, and as the Chairman has said,

some are not put in any series, but simply are made available owing to the very narrow interest in the subject matter that is contained in the document. There is publication in the scientific journals. There is publication by the contractor who employed the person who wrote the paper. There is publication at times by the Government Printing Office, when you want a wider circulation than you can get from the small run that the contractor makes.

Representative PRICE. With respect to people who have studied in basic research and people who work in the laboratories, they seem to feel that much of the necessary ordinary theoretical physics work done in our universities is not being done in our laboratories because of the press of research and development work.

In other words, they feel that real, basic research and theoretical work is being crowded out by the gadget phase of research. Do you believe it would be desirable to open up the field to broader university participation so as to get this theoretical work done?

Mr. STRAUSS. Mr. Price, one of the objectives of declassification is to obtain broader university participation. While it is true that there is a great emphasis on what we call programmatic work in our laboratories, I can assure you that we could not retain the men of the caliber that we have unless they also were able to conduct a certain amount of theoretical work—so-called basic work unrelated to the program—and that does go on in all our laboratories.

A very considerable number of our publications bear no relationship to the work in which the laboratory is engaged.

Representative PRICE. You mention the fact of retaining the people you already have in the program. Do you feel that any competent scientist who might have something to contribute in this field could be held out of the program for this reason or for the declassification reason?

Mr. STRAUSS. I cannot answer that. There is a continual recruitment going on. There are many personal reasons that lead a man to take or not to take the offer of a position in one of our laboratories.

As I say, the fact that the laboratory staffs increase is evidence that recruitment is successful. But some people do not like to live in the remote locations. There are various reasons. We find up to date less difficulty in recruiting for our laboratories than, I would say, in recruiting for experienced managerial jobs.

The competition with industry for our best people is very severe. They are constantly being tempted by salaries which we cannot in Government hope to equal. This is a more immediate problem even than our laboratory people.

Representative PRICE. On this matter of pointing out that the theoretical work in the universities throughout the country seems to be important in the light of your necessity, sometimes, of permitting your scientists to return to the universities; for instance, you state that Dr. Ruark will be with you for 2 years. It takes him almost a year to get familiar with this program. So actually you get probably 1 real good year out of them and then they go back to the university.

Will these people be so spread through the universities, who have worked with you, that they could take off a lot of the burden of the theoretical research?

Mr. STRAUSS. I feel that the 2-year period is too short and we will probably in 1 or 2 cases do our best to extend it. As you know, there are all sorts of complications. I refer to one without naming it, which recently we brought to the attention of the committee, where a very competent man with whom we had hoped to make a long-term association was involved in a conflict-of-interest situation.

He had patents or claims, or whatever, that we felt, and I believe your committee felt, prevented us from recruiting him. We cannot overlook the fact that many men who have been in this field in the last 10, 15, or 20 years have made contributions to the art in the shape of patents of which the Government has availed itself under the wartime legislation without compensating them.

These people have claims against the Government. They are justified claims, in many cases, of substantial amount. They are eliminated not by any reasons of classification. They are eliminated by the basic law of the land that prevents a conflict of interest. We work in a jungle of difficulties and we have to hack our way through the underbrush.

Representative PRICE. How many people in a project would be in the situation such as Dr. Ruark, who is on a leave of absence for a limited number of years?

Mr. STRAUSS. I could not give you a number, Mr. Price. We could give you some estimates for the record. But they are not too numerous. In academic life it is hard to find a man—in any career—who will upset his affairs and his family for 2 or 3 years, moving into an expensive environment. These are, as a rule, not men of established means, and it is a very great sacrifice for them.

Representative PRICE. It would not only be a sacrifice, but it would also adversely affect the program unless you had a continuity of effort.

Mr. STRAUSS. The Congress could do nothing more useful for the atomic-energy program and the science programs of the whole Government than to make it possible to pay salaries at the top academic levels for the qualified people that we would like to enlist.

I know of another instance which I will mention to you without names, of a man making—let me see—$25,000 a year in his university. He is being offered and probably will take a job in Washington at $16,000. He has a growing family of young children and no capital. It is not fair, and yet that kind of thing is being pressed on these men as a patriotic duty.

Senator ANDERSON. May I refer to an event that took place recently? I have a transcript of the press conference held at the United States Atomic Energy Commission, January 8, 1958. I will go to page 27. There was a question:

Question. Mr. Chairman, what is the current status of Project Rover, and something which was referred to in the morning paper as Project World Series, which is more mysterious?

The transcript shows "Laughter." Then Chairman Strauss says:

Dr. Libby, would you undertake to answer that?

You may remember, Dr. Libby, you spoke as to Project Rover and said it was classified. Then you said:

"On the other thing, I have never heard of it," and Mr. Fields said, "I think it was born last night by Senator Anderson," and after that "Laughter."

In connection with the extreme laughter, I have just obtained from my safe registered receipt 1021044. This is listed from the Deputy Secretary of Defense, December 5, 1957. There is a number on the registration slip of B–50127. I want to be sure, Mr. Chairman, that the justifications of laughter are well taken by the Commission. This reads:

"Resume of World Series studies, AFMDC, CONT, No. A–1577842, undated."

It reads:

In July 1955, Holloman proposed a satellite vehicle in response to a request from headquarters of the ARDC. The conditions under which this feasibility study was conducted were that this scientific satellite was to be launched during the IGY, June 30, 1957 to December 30, 1958, and that maximum use was to be made of the ICBM effort with minimum interference to that effect. Holloman in its Project World Series engineering study proposed a satellite—

and I have to leave out; this is a secret document and I know what parts are secret—

the combination would have put something in orbit at 300 miles altitude. The takeoff weight of the combination would have been 238,900 pounds, and so forth.

Then they made a revision that would have provided for a project that would have put a 1,180-pound missile into the atmosphere—the scientific payload of 1,180 pounds—at an orbit of 300 miles. Those materials were filed in March 1956, which was quite a bit prior to "last night."

They were filed under this heading: "Studies on Ballistic Test Vehicles and Analysis of Problems Associated with Advance Reconnaissance Satellite."

This is a secret document, and I have the original also locked up in case I need it some time, signed by the major general in command of the area. I only hope that the next time that laughter is induced by something that I have referred to, which I think was extremely unfortunate, that the Atomic Energy Commission might call me and ask me if the laughter was fully justified in the press release. It just so happens that the Russians put up almost the exact design, so far as we know, as Holloman had suggested. The weight is almost identicad, 1,180 pounds. It is unfortunate that Dr. Goddard's rocket became the German V–2. It is unfortunate the studies that Holloman Air Base made were filed in Washington and nothing further was done with it.

When somebody interested in explaining why we got behind the Russians refers to them, I hate to have the combination say that it was born last night.

Mr. STRAUSS. Senator, let me say that as far as the occurrence of laughter in the transcript is concerned——

Senator ANDERSON. You like to take a dig at me. I do not blame you. I will be available right along for these digs. I simply say it is somewhat foolish to put them in the record when I happen to be talking about something that is the truth.

Mr. STRAUSS. Senator, I know nothing about the project. I never heard of it.

Senator ANDERSON. But you chuckled when you read the record, did you not?

Mr. STRAUSS. No. I have not read the record.

Senator ANDERSON. You had passed on this before it was issued because your name is all through it.

Mr. STRAUSS. It is not there all through it. I was not there on adjournment.

Senator ANDERSON. You were there at adjournment. This is the last page. The last page said quite the contrary.

Mr. STRAUSS. There were two press conferences.

Senator ANDERSON. I said January 8.

Mr. STAUSS. You said 1958.

Senator ANDERSON. Mr. Reporter, read the statement to him.

(The record was read by the reporter.)

Mr. STRAUSS. I apologize. There were two press conferences in January. Since we were talking about the controlled thermonuclear program and about the scientists who were present, I assumed we were talking about that press conference. I do not believe it is the press conference you have reference to there. I think that is a different press conference.

Senator ANDERSON. I know it is a different press conference. I read them both with great care.

Mr. STRAUSS. As far as the laughter is concerned, the room was full of friends of the press. I could not tell who laughed and who did not. I cannot tell whether I laughed or did not.

Senator ANDERSON. I said when this came to your desk for editing, you read right through that and I can imagine the chuckle of glee you had when you got there. It just happens that I knew what I was talking about.

Representative PRICE. Perhaps the AEC should invoke the House rules rather than the Senate rules. We are not permitted to put in "applause" or "laughter" in the House Record.

Mr. STRAUSS. I think if you read the press conference, those which I have held, you will find that I have been the butt of laughter many times myself. I am likewise sensitive to it, Senator, and for that reason if this caused you any unhappiness I will apologize, although I had nothing to do with the subject.

Mr. FIELDS. Senator, may I join in that apology, too. I assure you that my remark had something to do with it, and it was very inappropriate, I agree; I was under the impression that this only involved the naming of the project. I had never heard the name and I apologize.

Senator ANDERSON. I have made the point several times that one of the unfortunate things of the whole satellite business is that nobody ever heard of this satellite, but attention was given instead to the Vanguard missile which most people were fairly sure was not going to succeed. Attempts were made to test the components of the Vanguard missile in places where it might have been proved. Those were tossed aside.

Mr. STRAUSS. The fact that this is a project with which the Commission had no connection is clear to you, I am sure.

Chairman DURHAM. Senator Hickenlooper?

Senator HICKENLOOPER. I had one question that occurred to me. Mr. Chairman, you said some time back in your testimony discussing

the vote of scientists on declassification, to the effect that on the question of whether we should go into thermonuclear development, that there was some scientific vote substantially against it. I did not get that clear.

Mr. STRAUSS. I refer, Senator, to a matter that is still classified in detail and which occurred in 1949, when the great debate upon the subject of whether or not we should develop a thermonuclear weapon had not yet been resolved by a decision of the President.

Senator HICKENLOOPER. I thought you gave some statistical reference.

Mr. STRAUSS. Yes. It was generally understood to be a unanimous decision, but 1 of the members of the committee of 9 was not in the country and did not participate in the vote.

Senator HICKENLOOPER. In other words, the so-called unanimous decision at that time was against going into the thermonuclear project?

Mr. STRAUSS. Yes, sir.

Senator HICKENLOOPER. I thank you. That is all.

Chairman DURHAM. Are there any further questions? It is getting late and I believe we will adjourn and come back at 2 o'clock.

(Whereupon, at 12:10 p. m., the Joint Committee recessed, to reconvene at 2 p. m. the same day.)

AFTERNOON SESSION

Chairman DURHAM. The committee will come to order.

Mr. Strauss, Senator Hickenlooper would like to ask you another question before you leave.

Senator HICKENLOOPER. Thank you, Mr. Chairman.

Thinking about the testimony this morning, I came to the conclusion that there might be some misunderstanding in connection with the matter of the presentation of the atomic power program of the Commission. I was afraid that the matter might not be cleared up.

I will make a preliminary statement.

I was not aware until this morning when I got a call from the executive director of the Joint Committee staff, Mr. Ramey, telling me that it had been decided, and I believe he said mutually, between some members of the committee and the Commission that under all the circumstances it was agreed that the presentation of the Commission's power statement could be postponed until the close of the other testimony in other categories. That was the first that I heard about it, and I came immediately to this meeting.

I sensed this morning that there might have been some feeling that the Commission was attempting to avoid or to postpone on its own motion a discussion of their attitude toward power. I took the liberty of making some inquiry, and I shall not testify here, but I would like to ask you, Chairman Strauss, did you in any way initiate or did any members of the Commission initiate the postponement of the presentation of the Commission's power program or a discussion of it at this time, as was contained in the preliminary statements which came in 2 or 3 days ago in my office and which contained a discussion of the power program?

Mr. STRAUSS. The answer to that is no, Senator, we had intended to present that section of the report today and we did not initiate its postponement. We concurred in it and are prepared.

Senator HICKENLOOPER. How did you concur in it? I would like to get the source of this so we will clear it up once and for all.

Mr. STRAUSS. Perhaps I had best ask the general manager to relate the conversations between himself and Mr. Ramey, following which I discussed the matter with Mr. Durham.

I believe the matter was initiated by a telephone call to the general manager by Mr. Ramey.

Mr. FIELDS. Mr. Chairman, as the committee is aware, the members of the staffs have been having informal discussions on the Government's nuclear power program. We have had about 2 or 3 meetings. Those discussions have not been completed.

The Commisson and the committee have also had discussions, and as I understand, there will be another one. Because this matter is still proceeding, Mr. Ramey suggested to me in a telephone conversation on Monday that we allow them to proceed to their termination—that it had been his thought—he had been thinking about how we might allow these to proceed. He discussed with you, Mr. Chairman, that perhaps the hearing should be deferred because of this.

I understand from his conversations that you felt that the hearing could not be deferred, and since it was set it should proceed and an alternative apparently was suggested, as I understand from the conversation, that perhaps the civilian power section should be deferred.

That was Monday afternoon about 3 or 4 o'clock, as I recall, and I undertook to sound the Commissioners out. I undertook to determine what the Commission view was and to talk to Mr. Ramey in the morning. I understood that he was going to talk to you as to whether this was a reasonable approach to the problem.

There is a desirability of having these discussions complete, if possible. I talked to Mr. Ramey in the morning and then he talked to you on this subject.

Senator HICKENLOOPER. By "you," whom do you mean?

Mr. FIELDS. Mr. Durham, sir.

As I understand, Mr. Ramey did talk to Mr. Durham in the morning, so by the mutual agreement, this would be deferred.

At that point Chairman Strauss, as I understand, talked to Mr. Durham and in the conversation it was mutually agreed that this would be deferred. That is my understanding of it, sir.

Chairman DURHAM. I do not recall the conversation because I had already read Mr. Strauss' statement, and I did not see how you could postpone it at that time.

My first reaction was not to do so, but under the agreement between you and Mr. Ramey which you transferred to the Commission, I thought that it was a mutual agreement between you, and that you had some Budget Bureau problems that you wanted to discuss with the Budget Bureau.

Mr. FIELDS. We had not completed our informal discussions of this matter. We had steps to proceed further on this.

Chairman DURHAM. That is what I understood.

Mr. FIELDS. I understand from Mr. Ramey that he had talked to a few members of the committee, including yourself and Senator Anderson, on this subject as to what should be done and whether it would be appropriate to defer the whole hearing or his part of the hearing. It was my understanding that, rather than defer the whole hearing, it was the preference that this section on civilian power be deferred. This was, as I recall, the conversation with Mr. Ramey.

Senator HICKENLOOPER. Mr. Chairman, let me say I have no objection whatsoever to the deferment of the discussion of the civilian power matter until a later date when perhaps more data will be acquired. That is not the point.

I was approached twice during the noon hour asking if it was my impression that the Commission was attempting to avoid the discussion at this time of the public power issue. I want to get this thing cleared up.

Mr. FIELDS. There was no discussion of avoiding it other than looking toward the future to determine whether the discussion as to where the program should go, could be completed in these informal discussions, before they were taken up in the hearing it would then seem to proceed in a much more orderly fashion.

Senator HICKENLOOPER. Again I repeat, I have no objection to it.

As I understand it, your understanding is that it was the result of a mutual agreement, as a result of discussions between the Joint Committee staff and yours.

Mr. FIELDS. Senator Hickenlooper, I would like to make clear it came up in a conversation, and I believe Mr. Ramey will attest that he suggested that he had been thinking about this because we had not terminated our informal discussions and it might be appropriate to defer this, and it was his suggestion.

Senator HICKENLOOPER. I can see very strong arguments why it might be more appropriate at a later date when more data is accumulated and the presentation can be made a little better. But I was disturbed during the noon hour because of the approaches that were made to me, asking if I thought that the Commission was attempting to dodge or avoid the discussion of the civilian power program at this time, and I was not of that impression because I had seen the statements that had come to my office a few days ago preliminary to these hearings. I just want to get it cleared up. I am raising no objection whatsoever.

Chairman DURHAM. Mr. Ramey.

Mr. RAMEY. I think what Mr. Fields said is essentially correct. This was initiated by the staff and worked out in that manner. I consulted with Senator Anderson, Mr. Van Zandt and others of the committee that I was able to reach. We had a relatively short time to reach all members.

Senator HICKENLOOPER. You reached me this morning. I had no objection. I thought it was perfectly all right. I merely bring this up because of the connotation of the two approaches made to me during the noon hour.

Senator ANDERSON. It seems to me it is a very desirable step because if we were able to reach some sort of agreement as to what the program would be, we could save a lot of time in the hearings, whereas, otherwise, we will be wrangling about the public power program. That is the only thought I have in the matter.

If there is any possibility of an approach, it would be helpful. I know the chairman of this committee wrote a very fine letter about it. If he can save some time, it seems desirable to do so. I know all of us have all the committees we can attend.

Chairman DURHAM. I thought it was an accommodation to the Commission as well as to the committee.

In the beginning I felt, since Mr. Strauss had already prepared the statement and I read it, that you could not do that at this time. But if anybody else wanted to do it, it was agreeable with me. I suppose the staff discussed it with Mr. Fields. I do not know whether they discussed it with the Commission or not.

It was perfectly agreeable to me to postpone it in face of the facts.

Mr. STRAUSS. Mr. Chairman, I am happy to note that we are all in agreement and that there is no impression on the part of any of you gentlemen that the Commission is stalling or has stalled or in any way delayed the presentation of the record of 1957 in this area.

Chairman DURHAM. I had no thought whatsoever of that.

Mr. STRAUSS. I am sure you have not.

Chairman DURHAM. Dr. Libby, we are very glad to have you with us, and you may proceed with your statement.

STATEMENT OF DR. W. F. LIBBY, COMMISSIONER, ATOMIC ENERGY COMMISSION

Dr. LIBBY. Mr. Chairman, I will speak on the radioisotope and radiation demonstration program first.

The Commission feels that the Nation has every right to be pleased with the contribution which radioisotopes are making to the economy and to human welfare here and in other countries. The savings to industry have increased, and there has been a steadily rising private industrial activity in producing and processing radioisotopes and in putting them to work.

Commission staff estimates indicate that through using radioisotopes in various processes, private industrial concerns now are saving more than a half billion dollars a year.

Last year the Commission submitted to the Joint Committee a tabulation indicating that industry was saving some $400 million a year by use of radioisotopes. Since that report was made, 174 more industrial concerns have been licensed to use radioisotopes, an increase of 18 percent over 1956.

The broadening benefits from applying radioisotopes to the problems of medicine and agriculture are more difficult to measure in dollar terms than are industrial savings. They are, however, rapidly increasing. Nineteen hundred organizations are using radioisotopes for medical purposes. Rich rewards are beginning to be realized from plant and animal studies.

In all phases of radioisotopes usage, the number of licensed organizations has increased 22 percent over 1956. The quantities of radioisotopes purchased from the Commission have increased by 47 percent, including a 50-percent increase for radiocobalt, and a 25-percent increase for all other radioisotopes.

The Commission has presented to the Joint Committee a comprehensive summary on uses of radioisotopes for all these purposes in the 23d semiannual report, pages 25–71.

While it is true that the contribution which nuclear radiation and radioisotopes are making to human well-being has already been demonstrated, when we compare what has been done with what remains to be accomplished, we are far from satisfied with the rate of progress in this field and are embarking on a vigorous new program to explore and exploit the full potential of nuclear radiation in isotopes.

In this connection, the Commission has taken the first step within its present budgetary limitations. In December it established the Office of Industrial Development, which will have as a principal concern the development of the industrial and agricultural uses of radioisotopes and nuclear radiation.

The Commission's activities in this field will encompass the following 4-part program for which the Congress has been asked in the President's fiscal year 1959 budget to provide funds in the amount of $5 million:

1. Isotopes demonstration program: To encourage cooperative efforts by AEC and industry to demonstrate new and to exploit known industrial uses of radioisotopes and nuclear radiation.

2. Industrial process radiation program: To accelerate development of economic application of high-level radiation to industrial processes.

3. Industrial isotope production program: To encourage and provide incentives for private production of facilities and materials needed for full-scale exploitation of the application of radioisotopes and nuclear radiation.

It is reasonable to expect that programs of this type, coupled with an ever-increasing interest on the part of industrial groups—as is indicated by an 18-percent increase in the number of industrial users in 1956—will bring about industrial economies which will dwarf to insignificance the savings which have already been realized. Only when the so-called waste materials of the present take their rightful place as useful industrial materials of the future can the ultimate economic potential of nuclear energy be realized.

That completes the remarks on the isotope radiation section. The next subject is the problem of manpower requirements.

Overall national attention must continue to be given to increasing the supply of scientists and engineers available to work in the atomic energy program.

Of four surveys which the Commission undertook last year in order to determine with greater exactitude the national needs for atomic energy scientists and engineers, two have been completed—those covering Commission and contract operations, and those covering private industry—and the third, dealing with academic requirements, has already produced some useful preliminary estimates. The evaluation of Federal requirements outside of the Commission remains to be completed.

Whether or not maximum anticipated demands develop, it is clear that the Commission must continue to press forward with its efforts.

The Commission intends to continue to assist colleges and universities with atomic facilities and faculty training. It will also contnue to provide a limited number of special fellowships and will look to the more distant future by providing a variety of assistance to high-school students and teachers to interest younger students in the rewarding field of science.

The Commission will complete its surveys of manpower requirements and keep them up to date, so that their findings can be correlated with its manpower programs.

Information base for the atomic industry: During 1957 all segments of the publishing industry—the business and trade press, scientific and professional journals, commercial book publishers, news-letters and other private groups concerned with disseminating technical information—continued to give emphasis to atomic energy subjects. The level of private publishing activity was much greater than that reported in last year's hearings.

The Commission's volume of declassified and new unclassified information issued was greatly increased, and the provision of classified information in documentary and oral forms to holders of access permits also increased.

During 1957 the Commission completed the second special classification review program in which 18,677 documents were reviewed, 1,668 documents were downgraded, 7,848 documents retained their original classification, 9,076 documents were declassified, and 86 documents were upgraded. In addition, 1,401 weapon test and military reactor reports were reviewed.

Major declassification steps which were taken were the declassification of plutonium purchase prices, the declassification of guaranteed fair prices to be paid licensees for production of special nuclear material, and placing of more than 100 civilian power and research reactors in the unclassified fields, thereby removing all security restrictions from these reactors.

During the year 1957, 359 access permits were issued to companies new to the program and 319 renewals of expiring permits were issued. The percentage of expiring permits which were renewed stood at 88 percent as the year ended. The access permit holders were more active in purchasing classified reports, although there were fewer classified reports.

The sales totaled 19,309 pieces and the receipts $15,186.99, compared with 14,668 pieces and $19,030.06 in 1957. Sales of unclassified technical reports also increased to 115,583 pieces from 88,000 in 1956. The 23d seminanual report to the Congress, pages 165–166 and 352–353, gives further details on access permit operations.

The Commission took three actions in 1957 which will foster wider dissemination of Government-developed technical information and at the same time enhance the profit opportunities of industry. The first of these was the initiation of a new series of industrial information releases. Mailed to the business and technical press, the releases report on Commission policy, program, and technical developments. Editors of over 400 technical periodicals and business papers are on the mailing list.

The second action was to offer Commission-sponsored scientific and engineering book manuscripts for commercial publication. After careful consideration it was decided that commercial publication would best serve the interests of the Government, the public, and the publishing industry. Some 8 or 10 manuscripts will be offered for publication in 1958.

The third was to contract for a series of technical progress reviews which will analyze current technology in the three following areas:

Power reactor technology, chemical processing, and solid reactor core materials. Additional reviews will be undertaken as the need develops.

During the past year there has been increasing awareness of Russian progress in the field of atomic energy. Greater effort has been made to obtain and translate Russian publications. The effort thus far has met with acceptance on the part of industry. However, the major complaint is that we are not doing enough.

There is now the beginning of a translation program in Government. Our own budget of $88,000 has made possible the translation of 2,400 pages of monographs and 2 complete journals.

An interdepartmental committee with representatives from the National Institutes of Health, Atomic Energy Commission, National Science Foundation, Office of Technical Services, Department of Commerce and Department of Defense is proposing a substantially increased program with provisions for coordination in order to avoid duplication.

During the year the industrial demands for depositories of AEC-generated information were met by establishing 6 classified depositories and 13 unclassified. The total of depositories, 85, and their geographic distribution now seem to be adequate to meet current demands.

Progess in the entire field of technical information is described in the 23d semiannual report, pages 162 to 174.

In the interest of developing the atomic energy program in industry, the AEC has attempted to distribute to industry as much useful technical information as possible. We do this in two ways: By either publishing in the open literature, or wide distribution of reports. There is little exchange between the industrial participants in the atomic energy program of information developed at private expense.

Further, the flow of this information from individual firms to the AEC for further dissemination is practically nil. We are hopeful that further growth of the business press coverage of atomic energy will fill this gap.

Chairman DURHAM. Thank you very much, Dr. Libby.

This new agency for training, will that be an entirely new item of expense this year in the budget?

Dr. LIBBY. Yes. We will begin small. We need to train people about the use of isotopes in much the same way that we have to do it for atomic power. There are special techniques of measurement that are necessary to detect the small amounts of radiation that are mandatory if you are going to use isotopes with complete safety.

Chairman DURHAM. Are you going to do training in hospitals throughout the country?

Dr. LIBBY. We have not worked out all the details and we will keep you fully informed on this. These programs are in a formative stage. This is practically the first announcement of them, Mr. Durham. They are in the process of generation.

I would say that we will move much in the same way that we have in the atomic power end of things; that is, keeping the universities as the main means of doing these jobs and we assist as needed and where needed to get the thing going. The details have not been worked out, but I could give you some examples.

Chairman DURHAM. The need for it would appear first in the hospitals because at the present time they are using them very extensively throughout the country.

Dr. LIBBY. The hospitals are probably one of the places where we will do a good bit of it, though I am not certain that industry will not also require a good deal of assistance in the education and training program for one of the great undeveloped areas of the use of isotopes in industry.

Despite the fact that we have enormous benefits, I estimate there are only about 10 percent of the potential savings. I think it is our job to bring in the other 90 percent as soon as possible.

A large part of this task is just to show industry that it is easy and very safe and cheap to do these things in their regular plant operations. So we will have to do some industrial training in industry. How much that will amount to, we cannot say just now. I hope it will be possible very soon in the isotopes training course at Oak Ridge to put in these extra parts which speak about the wider spread use of isotopes in industry.

Chairman DURHAM. Your plan is to train these people so that they can take over the job and not put us in this business forever?

Dr. LIBBY. That is exactly right. This is our policy across the board.

The school teaching job belongs in the universities and schools of the country and not in the AEC. But since we are developing new fields, we have to lead the way sometimes and assist them with, perhaps, apparatus, maybe nothing more than occasional loans of isotopes, and maybe just visit.

This is the sort of thing that is very similar to the way we proceeded with the universities in the nuclear power education program in the graduate schools.

Chairman DURHAM. It is natural that you should do it because you are the only source of information at the present time?

Dr. LIBBY. Yes.

Chairman DURHAM. Mr. Ramey.

Mr. RAMEY. In connection with your program of encouraging private production of radioisotopes, last year I believe there was some discussion in the hearings of a possible reactor that might make process steam, and also make cobalt 60 that could be used in radiation reactors and other industrial purposes.

Has there any progress been made along the lines of developing private reactors?

Dr. LIBBY. Mr. Ramey and Mr. Chairman, if you do not mind, I will ask Dr. Frank Pittman, who is in charge of this program, to answer this specific case.

Dr. PITTMAN. In that specific case, the people are still quite interested, Mr. Chairman and Mr. Ramey, in the possibilities of a reactor which will furnish steam to certain steam-using industries and will also produce cobalt when the demand for cobalt has reached the point where they can see their way clearing of going forward with a reactor of this type.

There are other potential uses for reactors other than electrical power and steam is one of the first ones that people will look at.

The company that was looking at this last year is still quite actively interested in that possibility.

Chairman DURHAM. Has any consideration been given to a demonstration program in this? People have said, if it could be demonstrated that you could make this economically in a small reactor costing a few million dollars, then industry could move right in and build more.

Dr. LIBBY. I think you can summarize our position, Mr. Ramey, in the following way.

We are going to increase the use of isotopes tenfold in the next 5 years, and we are going to do everything that is necessary to do that. That is our present program.

Insofar as I can determine it, I think this is the position of the whole Commission and the whole Government. We must do this and we can do it. We may be underestimating the potential, or we may be somewhat overestimating it, but I think it is about right. We may have to get industry into producing these isotopes, but we do not know yet.

I think it would be well to realize that as we go along the need and volume of business will become clearer. Cobalt is further along than most of the isotopes, as you well know, and we find that the cobalt business is pretty big. In fact, we are having some trouble. We are fairly close to the point where we do not have too much excess capacity on cobalt.

This cobalt company that you mentioned well knows this, and it is one of the reasons that industry is somewhat interested. I think the uses of the other isotopes will move into this category where industry may be interested in supplying the demand. I speak particularly about the misnamed waste products. They are not waste products. The atomic garbage that has been called waste products is really a great asset. As soon as we develop the uses of fission products that come out of the reprocessing of expended fuel elements, we will have a definite asset. At the present time, we have to pay money to store the things in tanks or haul them away, and it will be a definite asset as soon as we put these things to use in industry.

One of the parts of our demonstration program is to develop these uses. So, I think the answer to your question is "Yes"; we are trying to show in the demonstration program uses which will necessarily interest industry in the chemical reprocessing of fuel elements, which, in my opinion, in large part is the production not of waste products but fission products as isotopes which, in my opinion, are someway of greater promise to the average citizen than is atomic power.

Chairman DURHAM. I was going to ask you: Have you been able to meet all the demands for radioisotopes?

Dr. LIBBY. Cobalt is a little tight sometimes. But I do not believe we have had any real trouble.

Chairman DURHAM. You were speaking of the manpower requirements. I notice you speak of four surveys you made last year and state that the Commission is dealing with academic requirements and has produced some useful preliminary estimates. Are those estimates available at the present time for the record?

Dr. LIBBY. Yes; we can furnish those. Is that right, Mr. Fields?

Mr. FIELDS. I am sorry, I did not hear the question.

Dr. LIBBY. We have these estimates of the manpower requirements available for the record?

Mr. FIELDS. Yes, Mr. Chairman; we certainly have.

Chairman DURHAM. Most every agency of the Government at the present time is dealing with scientific manpower requirements. I think it would be well to put in the record what you have accomplished so far and what results you expect.

Dr. LIBBY. We will certainly do that.

Mr. FIELDS. I think we have reported these to you already. Mr. Smith, have we not?

Mr. SMITH. This particular survey you are referring to was only completed last week. We do have, I understand, as of today—I have not seen it today because, apparently, some of the mail was delayed over the weekend—and I am sure it can be provided for you in the next day or two.

(The information referred to follows:)

ATOMIC ENERGY COMMISSION,
Washington, D. C., March 12, 1958.

Hon. CARL T. DURHAM,
Chairman, Joint Committee on Atomic Energy,
Congress of the United States.

DEAR MR. DURHAM: In response to your request during the recent 202 hearings, we are enclosing copies of the preliminary results of our survey of the scientific and engineering manpower needs of colleges and universities participating in atomic-energy activities exclusive of Government contracts. This information was received from the American Society for Engineering Education just prior to the hearings, and the final report is now in preparation. Copies of the final report will, of course, be supplied to the committee as soon as they are available.

The report on scientific and engineering manpower requirements of the AEC and its contractors has also been prepared for distribution to the public. As soon as it has been printed, copies will be furnished to the committee.

The data in these two surveys supplement similar manpower information about privately supported atomic-energy activities in industry, which was developed by the Atomic Industrial Forum under contract with AEC. Copies of the Forum's published report were transmitted to your committee on October 4, 1957.

Sincerely yours,

W. F. LIBBY, *Chairman.*

Academic and research staff requirements for atomic-energy activities, 1956–57 academic year

	Number of faculty and staff scientists and engineers											
	Educational level (highest degree)				Specialized atomic-energy education				Specialized atomic-energy experience			
	Total	B. A., B. S., M. A., and M. S.	Ph.D., Sc.D., and M. D.	Not available	None	Short course under 1 year	1 year or more including graduate degree	Not available	Under 6 months	6 months to 3 years	3 years and more	Not available
ENGINEERS												
Aeronautical	11	9	2		4	7			9	2		
Ceramic	5	1	4			3	2		1	3	1	
Chemical	167	78	89		82	47	30	8	65	50	39	13
Civil	27	12	13	2	16	9	2		19	4	2	2
Electrical	97	71	25	1	59	22	11	5	46	22	14	15
Marine												
Mechanical	137	96	40	1	56	53	22	6	80	39	16	2
Metallurgical	66	22	44		32	20	11	3	20	25	19	2
Mining	3	2	1		3				3			
Nuclear	61	31	30		4	11	45	1	11	10	35	5
Other	48	32	14	2	19	24	5		21	15	8	4
Total engineers	622	354	262	6	275	196	128	23	275	170	134	43
SCIENTISTS												
Biological and agricultural	794	358	430	6	466	267	37	24	291	255	173	75
Chemist and biochemist	1,059	531	528		461	326	169	103	292	411	265	91
Geologist and geophysicist	60	35	25		22	6	2	30	14	9	6	31
Health physicist and industrial hygienist	42	26	16		8	2	31	1	2	13	26	1
Mathematician and statistician	18	4	14		9	1	4	4	9	3	4	2
Meteorologist	13	7	6		7		1	5	2	5		6
Medical	684	128	555	1	320	229	85	50	80	269	301	34
Physicist and biophysicist	967	450	514	3	332	154	386	95	289	300	278	100
Other	145	98	45	2	82	30	20	13	89	27	17	12
Not available	35			35				35				35
Total scientists	3,817	1,637	2,133	47	1,707	1,015	735	360	1,068	1,292	1,070	387
Total engineers and scientists	4,439	1,991	2,395	53	1,982	1,211	863	383	1,343	1,462	1,204	430

Academic and research staff requirements for atomic-energy activities, 1957–58 academic year

	Number of faculty and staff scientists and engineers											
	Educational level (highest degree)				Specialized atomic-energy education				Specialized atomic-energy experience			
	Total	B. A., B. S., M. A., and M. S.	Ph. D., Sc. D., and M. D.	Not available	None	Short course under 1 year	1 year or more including graduate degree or equivalent	Not available	Under 6 months	6 months to 3 years	3 years and more	Not available
ENGINEERS												
Aeronautical	14	11	3		4	8	1	1	9	5		
Ceramic	7	1	6		1	4	2		3	3	1	
Chemical	184	80	104		76	58	46	4	55	70	45	14
Civil	33	16	15	2	19	10	3	1	19	9	2	3
Electrical	119	80	38	1	65	30	18	6	47	38	16	18
Marine												
Mechanical	156	95	59	2	67	53	31	5	69	57	23	7
Metallurgical	85	28	57		38	31	15	1	27	34	21	3
Mining	3	2	1		3				3			
Nuclear	96	47	49		7	26	62	1	22	26	43	5
Other	43	25	16	2	18	21	3	1	19	16	5	3
Total engineers	740	385	348	7	298	241	181	20	273	258	156	53
SCIENTISTS												
Biological and agricultural	858	402	452	4	450	310	70	28	299	308	191	60
Chemist and biochemist	1,216	626	589	1	512	404	190	110	335	551	266	64
Geologist and geophysicist	50	25	25		24	9	3	14	13	14	8	15
Health physicist and industrial hygienist	48	33	15		6	10	31	1	5	23	20	
Mathematician and statistician	22	6	16		9	4	5	4	12	6	2	2
Meteorologist	10	5	5		4		1	5		5		5
Medical	732	152	578	2	339	252	92	49	126	290	278	38
Physicist and biophysicist	1,135	523	612		380	207	428	120	361	355	280	134
Other	140	89	51		74	33	23	10	81	33	21	5
Not available												
Total scientists	4,211	1,861	2,343	7	1,798	1,229	843	341	1,237	1,585	1,066	323
Total engineers and scientists	4,951	2,246	2,691	14	2,096	1,470	1,024	361	1,510	1,843	1,222	376

Employment of academic and research staff in educational atomic energy activities, by activity, function, and academic rank, at start of 1956–57 academic year

	Total number of faculty and staff scientists and engineers			Teaching only	Research and development only	Combined teaching and research and development	Not available
	Full time	Part time	Not available				
ACTIVITY							
Nuclear reactor theory and applications	36	225	4	127	25	110	3
Reactor components	8	56	2	14	29	23	----
Reactor materials	17	89	----	19	55	32	----
Nuclear fuels	17	98	4	15	69	35	----
Instrumentation	27	151	----	28	78	68	4
Irradiation studies	135	399	2	9	355	170	2
Byproduct applications	213	547	2	35	440	281	6
Biomedical	295	937	4	19	507	705	5
Health	36	71	4	19	25	67	----
Other	243	706	21	206	543	286	35
Total, all activities	1,027	3,369	43	491	2,126	1,777	45
ACADEMIC RANK							
Professors (full, associate, assistant)	552	1,683	18	314	725	1,062	152
Instructors, post doctorates, teaching and graduate assistants	441	1,647	14	141	1,215	586	160
Not available	34	39	11	----	38	15	31
Total, all ranks	1,027	3,369	43	455	1,978	1,663	343

Need for short courses

Course subject	Number of schools indicating need	Number of employees needing courses
Nuclear reactor theory and applications	121	310
Reactor components	14	30
Reactor materials	25	50
Nuclear fuels	30	49
Instrumentation	42	121
Irradiation studies	47	196
By-product applications	41	153
Biomedical	49	165
Health	22	41
Other	11	31
Total	402	1,146

Shortages of scientists and engineers, 1956

Occupation:	Number of people
Engineers:	
Aeronautical	2
Ceramic	0
Chemical	8
Civil	1
Electrical	13
Marine	0
Mechanical	11
Metallurgical	6
Mining	0
Nuclear	36
Other	17
Total	94
Scientists:	
Biological and agricultural	37
Chemist and biochemist	60
Geologist and geophysicist	1
Health physicist and industrial hygienist	12
Mathematician and statistician	7
Meteorologist	0
Medical	14
Physicist and biophysicist	61
Other	82
Total	274
Total, scientists and engineers	368

Chairman DURHAM. Thank you very much, Dr. Libby.

That is one program in which a great deal has been accomplished in the last few years. There has been a lot done in this field of radioisotopes that has meant much to the American people and the world.

(A portion of this day's testimony relating to uranium mining and milling industry problems, has been printed separately in the Joint Committee publication entitled "Problems of the Uranium Mining and Milling Industry."

STATEMENT OF HAROLD S. VANCE, COMMISSIONER, ATOMIC ENERGY COMMISSION

Mr. VANCE. Policy changed on prices and charges: The Commission took a number of significant actions during the past year in the field of charges for materials and services made available to private industry and in the field of prices for special nuclear materials purchased by the Commission from private industry.

Among the most important of these was the announcement by the Commission that it would process irradiated fuel elements from licensed reactors on a fixed-cost basis.

The Commission had been trying, and continues to attempt, to provide for privately owned and operated facilities in this field, but thus far these attempts have not been successful partly for the reason that the volume is too small to attract industry. As the construction of licensed reactors is already underway, it becomes necessary to make some interim arrangements for the processing of these fuel elements.

The Commission, in announcing these services, reserved the right to cancel any future contracts with reactor operators, in case a private processor was willing to process these fuel elements at reasonable charges.

The Commission also announced a new guaranteed minimum price of $30 per gram for plutonium produced by licensed reactors for the period from February 1, 1957, to June 30, 1963. Previous to this, the Commission had established a varying price to be in effect until June 30, 1962. The new $30 price supersedes this former schedule to the extent that individual prices were below this level.

The President announced that the total of uranium 235 available for domestic power reactors privately owned was increased to 50,000 kilograms from the previous 20,000 kilograms.

These and other steps and programs of assistance to industry are described in the Commission's 23d Semiannual Report, especially on pages 9 to 13.

Senator ANDERSON. At that point, Mr. Vance, there was a special report in Nucleonics in January of this year, that quoted Mr. Davis, of the Commission, and the question was:

As concluded at a recent American Nuclear Society symposium in New York, a large uncertainty in the fuel cost for a slightly enriched reactor seems to be the value of Pu. For a typical Pu reactor, the difference between $30 a gram and $12 a gram means 1.3 mills per kilowatt-hour. What assurance does the reactor investor have that he will not be put out of business by future changes in Government fissionable material prices?

The answer was, as quoted here on page 49 of this January issue:

I don't believe that the value of plutonium is the greatest uncertainty in fuel cost. We have regarded fuel-fabrication cost now so high with such potentiality for reduction as the principal operating cost of uncertainty at present time. No one can tell what price of plutonium will be over a 30-year life of a reactor being planned now. The AEC guesses that it will be worth $12 a gram for fuel reactors when this use becomes technically and economically feasible, and the best assurance for any investor is to assume that the long-term price will not exceed this value.

Will you comment on what Dr. Davis told the industry in light of the action of the Commission?

Mr. VANCE. I think the action of the Commission was consistent with what Mr. Davis said, Senator.

If you wish me to comment on this subject, I first refer you to my testimony of a year ago.

Senator ANDERSON. Mr. Holifield asked you something about this value and you said:

Mr. Holifield, I would like to say something in that connection. The last conversation I had with Walker Cisler, I told him that I thought he was pursuing a very dangerous course in estimating plutonium income over the useful life of his reactor.

Representative Holifield said:

I agree with you.

Then you said:

I think it is thoroughly unsound for anyone building a reactor in this country or abroad to give anything but nominal weight to the value or sales value of plutonium produced, because sooner or later that price is going to be $12 a gram or less and that the effect upon the cost of electricity produced is less than 1 mill. I think the person building a reactor, assuming he can get $30, for example, per gram of plutonium produced, is building a house on sand.

Would you say this was an attempt to put a rock foundation under it?

Mr. VANCE. No, sir; I agree thoroughly with the statement you have just read.

Senator ANDERSON. This is your statement.

Mr. VANCE. I know it and I still subscribe to it. But I think there is this to consider, Senator: An individual or a company or a public-utility group, or even a government, contemplating the building of a nuclear reactor today has to think in terms of its probable useful life, and that may well be the estimated useful life of a conventional plant today which is of the order of 30 years.

Now, I am hopeful and I think you are, too, that much short of 30 years we will come to the end of a need for plutonium for weapons purposes.

Senator ANDERSON. Yes; I would hope so.

Mr. VANCE. Consequently, I think a man making a financial plan for 30 years should not give much weight in that financial plan to the possibility of his being able to sell plutonium for weapons purposes over that period of time. He certainly has no guaranty at the moment.

The guaranty at the moment is for 7 years only. Therefore, I think from a strictly business standpoint that depends upon the ability to sell plutonium at weapons prices as a financial factor that makes the reactors feasible—I mean financially—sound economically or not is wrong.

That is what I said a year ago, and I agree with it still.

I do agree, sir, that there is a shorter period of time in which we will need plutonium for weapons purposes. In that shorter period of time, I think we should pay a reasonable price for the plutonium that we use for weapons purposes, but only so long as we use it for weapons purposes.

Senator ANDERSON. In your comment at the hearing last year, which I just read you, you referred to Walker Cisler. In the hearings that were held in 1953 when the act of 1954, the Cole-Hickenlooper Act, was considered, Mr. Cisler sent a telegram to the then chairman of the committee, Sterling Cole, carried on page 150 of those hearings, and without reading all the long message, he said:

> If our studies indicate that a high-temperature breeder reactor is commercially competitive considering both heat energy and reactor products and we are hopeful they will, we propose to design, construct, test, and operate such a reactor using private investment funds and without Government subsidies, plutonium-purchasing contracts, or guaranties of any kind.

So the Mr. Cisler that you referred to did not want any Government purchase contracts of plutonium and clearly indicated that. Then he got on the stand, and this is page 156, and Mr. Holifield said:

> No one else would be allowed to buy it under present law, and certainly it would not be released in uncontrolled fashion into the general markets as other materials are because of its bomb-making properties.

Mr. Cisler said:

> That is true, whatever use is made of the plutonium produced would have to be in keeping with the law as it is written, but I do want to make it clear that we are not seeking any contracts or any guaranty for the purchase of plutonium on the part of the Government. What we produce must find its place in competition with the Government's own production of plutonium.

So if he did not want any contract, if he did not want any assurance of Government purchases, why did the Commission announce this 5-year contract running into June 30, 1963? He has none to sell during that period.

Who does have any in this country?

Mr. VANCE. Which 5-year contract do you mean, sir?

Senator ANDERSON. I am reading from your testimony on page 28. It says:

> The Commission announced a new guaranteed minimum price of $30 per gram for plutonium produced by licensed reactors for the period February 1, 1957, to June 30, 1963.

Mr. Cisler does not want any contract. I do not believe he would have any to sell, anyhow, during this period.

Who is going to have any plutonium to sell in this country from February 1, 1957, to June 30, 1963, as you see it?

Mr. VANCE. Senator, this 5-year contract that you speak of was not a 5-year contract in the real sense of the word. It was an extension for 1 year only of contractual commitments that have previously been made.

Senator ANDERSON. I do not believe we are reading out of the same book. I am reading from your testimony, and you said on page 28:

> The Commission announced a new guaranteed minimum price of $30 per gram of plutonium produced by licensed reactors for the period from February 1, 1957, to June 30, 1963.

Who do you expect is going to be producing that plutonium in this country during that time?

What reactor is ready to start selling to the Government?

Mr. VANCE. I should say there would be very little of it offered at that time.

Senaor ANDERSON. Why jump the price unless it was to fix a level that could apply to Mr. Cisler in the years following 1963?

Mr. VANCE. The price was not jumped, Senator.

Senator ANDERSON. If it was not jumped, how do you explain your own testimony? Your statement is:

> Previous to this, the Commission established a varying price to be in effect until June 30, 1962. The new $30 price supersedes this former schedule to the extent that individual prices were below this level.

If you did not raise it, why do you say "were below this level"?

Mr. VANCE. Because the guaranties that had been in effect prior to the establishment of this $30 price ranged, depending upon, let us say for the sake of this public hearing, the purity of the plutonium, all the way from a low—I do not know what the low was—$12 up to somewhere around $44.

Senator ANDERSON. It could be $46 even?

Mr. VANCE. And the $30 is a substitute for this sliding scale of prices if the reactor people want to take the $30 rather than the sliding scale.

I put it that way for this reason.

Senator ANDERSON. What are you going to do with the $12 rate? Are you going to give them $30 also?

Mr. VANCE. No.

Senator ANDERSON. Is not that a flat $30?

Mr. VANCE. The point, sir, is this.

Senator ANDERSON. Is not that a flat $30?

Mr. VANCE. Yes, it is a flat $30.

Senator ANDERSON. Then what are you going to do about the stuff that is worth $12? You are going to give them $30?

Mr. VANCE. Yes, but for a very good reason.

Senator ANDERSON. Yes, but what is the reason?

Mr. VANCE. I think it is classified, Senator.

Senator ANDERSON. You announced it. We are only shopping here this afternoon. You have something that you say is worth $12. You are going to give them $30. We ask you why; you say it is classified.

Mr. VANCE. The point is that previously it was worth only $12, but now it is worth more than $12.

Senator ANDERSON. After you raise the price, sure.

Mr. VANCE. I will be glad to tell you in a closed session why it is worth more than $12 now, but was not then.

Senator ANDERSON. The American public does not want it in a closed session. They want it in the open.

Mr. VANCE. I think it is classified information. It has to do with the weapons program.

Senator ANDERSON. Did not the AEC issue a press release at the time explaining it in great detail?

Mr. VANCE. I do not understand what you are getting at.

Senator ANDERSON. I thought I made it clear.

Did not the AEC at the time of announcing a $30 price issue a press release trying to explain it?

Mr. VANCE. I suppose there was a press release. I do not recall. I do not think the press release went into the detail as a reason for it.

Senator ANDERSON. Very well.

There are those, of course, who think that this changes the whole financial situation with reference to a particular reactor.

Mr. VANCE. I think I can say in this open session that whereas the time the sliding scale price was offered, the type of plutonium, the quality of plutonium for which the price was $12, could be used only for fuel, that is no longer true. I think that is as close to the answer as I should give you in this session.

Senator ANDERSON. That will be close enough.

(A portion of today's testimony relating to uranium mining and milling problems has been printed separately in a joint committee publication entitled "Problems of the Uranium Mining and Milling Industry.")

Chairman DURHAM. Are there any further questions? If not, you may finish your statement, Mr. Vance.

Mr. VANCE. The next subject, Mr. Chairman, is supplying a developing atomic energy industry: During the past year the Commission has continued in its efforts to encourage participation by private industry in supplying the atomic energy industry with the basic material and services.

Our efforts were successful in parts of the so-called fuel cycle, and particularly with respect to certain cold processing activities. The Atomic Energy Commission is currently the sole supplier of special nuclear material and the principal supplier of source material.

However, before the material supplied by the Commission can be incorported into fuel elements, it must be further processed and refined.

Recently, private companies have begun to process enriched uranium into uranium oxide and metal for use in fuel elements and to produce thorium and thorium compounds.

Private companies have also entered the field of recovering unirradiated uranium scrap, a service that the Commission formerly had to perform for private business. The Commission also continued its efforts to encourage private industry to enter the field of hot processing of radioactive material, but the results thus far indicate that industry is not yet prepared to undertake this activity.

The Commission has also announced recently that it would discontinue its gamma irradiation service to the extent that such service is commercially available. A recent Commission survey indicated that at least 16 academic and industrial organizations are now able to provide irradiation on a commercial basis. We believe this is a sufficiently large number to assure service at reasonable prices.

In encouraging private industry to assume the task of supplying the atomic energy industry with its unique materials and services, the Commission is conscious of the fact that costs are a most important factor in the progress of the atomic energy industry. While the process of shifting the supply base from the Government to private industry may, particularly in the beginning, involve some cost increases to the users, we believe that these increases will not be significant and that in the long run free competition will help lower costs and prices.

Progress of private industry's participation in the atomic energy program is reviewed in the 23d Semiannual Report in pages 137–161.

The Commission intends to continue this program of encouraging industrial development and hopes to obtain industrial participation in those areas of the industry where none exists today. The chemical reprocessing of spent fuel elements, the production and distribution of various radioisotopes are some of the areas that might represent opportunities for private investment.

On patents, the Commission announced on November 19, 1957, that it plans to review its patent policies and requested written comments by any interested person. In addition, we have extended an opportunity for persons to request an oral presentation of their views. In our judgment, the experience accumulated in past years provides a basis for a review of our patent policies.

Representative HOLIFIELD. Mr. Chairman, at that point could I ask if there has been given to the Committee a list of patents which the Commission has exercised its right to obtain? Has there been a list in the last few years?

Mr. VANCE. General Fields, can you answer that?

Representative HOLIFIELD. Or have there been any patents that were considered important?

Mr. FIELDS. You will find listed in the semiannual reports of recent date, lists of patents that have been issued since the lifting of the secrecy order, so that this has been provided. From time to time this has been done. I believe I am answering your question, Mr. Holifield. If you are asking the question, have we used the section that declares it effective with the public interest, this is another category.

Representative HOLIFIELD. I am asking you if the Commission has found any patents which they felt were in the public interest and have secured those patents for the United States Government, or have

all patents been considered unimportant and not in the public interest and been granted to anyone who requested them?

Mr. DIAMOND. Mr. Holifield, maybe I can answer the question you have in mind. Under our contracts, we do have patent provisions which afford in most cases the Government the right to acquire the patent.

Representative HOLIFIELD. I am aware of that. I am asking if you have exercised the right.

Mr. DIAMOND. We have exercised the right. We have applied for patents and patents have been issued. I believe from time to time we have advised the joint committee of the patents that have issued, and the fact that we have offered to the public royalty-free licenses for their use.

Mr. FIELDS. Mr. Holifield, the extract of the 23d semiannual report on page 337 has an appendix that lists the 126 patents owned by the Government that are now available for licensing to users. Licenses are granted on a nonexclusive basis. The total number of patents available for licensing is 1,345.

Representative HOLIFIELD. I understand all that, but that is not my question.

Mr. FIELDS. I did not think it was your question.

Representative HOLIFIELD. I am aware of that. My question was, Has the Commission exercised its right to obtain patents and withhold them in the national interest? I know you have made a lot of patents available and you have granted private industry the right to obtain a lot of patents as being not necessarily in the Government's interest or coming within the category of qualification. The question I asked was, Have you taken any patents and withheld them either because of their importance or because of military security?

Mr. STRAUSS. The question is clear to me. What Mr. Holifield is asking is have we exercised our authority to state that certain patents are in the public interest and not to be published and have we done that recently, I assume in the last year. That I assume we should be able to answer.

Mr. DIAMOND. We have not exercised our patent in the public interest. There has been no occasion for this yet.

Representative HOLIFIELD. This is what I anticipated when the so-called catfish language was written into the patent provision. I just wanted to verify my prejudices and suspicions.

Senator ANDERSON. Mr. Vance, at page 28 of your testimony, you mentioned this $30 per gram for plutonium produced. Are you under the impression that the range is now from $12 to $44 or was prior to that time? I think it was and I think you said you think it was. Was there not a range from $12 to $44, let us say?

Mr. VANCE. Approximately that; yes.

Senator ANDERSON. Did you think that this announcement of the $30 price did more than raise the $12 up to $30, or did it bring the $44 down to the $30?

Mr. VANCE. No, sir, it does not bring the $44 down to $12 because we have a definite commitment that was made some time ago, long before I joined the Commission, that we would pay $44 for a certain grade of plutonium.

Senator ANDERSON. So all it does is raise the $12 minmium up to $30?

Mr. VANCE. That is correct.

Senator ANDERSON. Was there any possible connection with PRDC in connection with that? PRDC was approved March 26, 1957, and this announcement followed by 45 days later, raising the $12 grade up to $30.

Mr. VANCE. In the first place, Senator, this guaranty as it stands today would have less effect on PRDC because when their construction period ends and by the time thereafter when they would extract their first fuel elements to be reprocessed—and that would have to precede there being any plutonium available for sale to us—this commitment would have expired or it would have been within a matter of months.

Senator ANDERSON. It would not be used as a precedent for the next contract they got?

Mr. VANCE. I beg your pardon?

Senator ANDERSON. It would not be used as a precedent in establishing the price for future deliveries?

Mr. VANCE. We have no commitments beyond this period for which we are authorized to make them. As a matter of fact, the actual commitment as of this date is, I believe, General Fields, 5½ years instead of 7.

Mr. FIELDS. The guaranteed period runs to June 30, 1963, at the present time.

Senator ANDERSON. At the time the press release came out—and Mr. Chairman, I would like to ask that the press release that was issued on May 18 would be put in the record so we know what we are talking about—at that time the press release said in making such extension the Commission expects that the guaranteed fair price for plutonium will be reduced as dictated by consideration and value of the material for its intended use by the United States, and giving such weight to the actual cost of producing it as the Commission finds to be equitable to a level based upon the fuel value of plutonium in commercial power reactors.

(The press release referred to follows:)

AEC ANNOUNCES PLUTONIUM PRICE SCHEDULES

Lewis L. Strauss, Chairman of the United States Atomic Energy Commission, today announced prices to be paid by the Commission for plutonium produced in the operation of licensed power and research reactors in the United States between now and June 30, 1963.

For purchases between now and July 1, 1962, the price will range from $30 to $45 per gram depending on the plutonium 240 content of the material. For the year July 1, 1962–June 30, 1963, a single price of $30 per gram will be in effect. These prices supersede all previous guaranteed fair prices for this material and details of the new schedule will be published in the Federal Register.

The 1954 Atomic Energy Act authorized the Commission to guarantee prices domestically for a period not to exceed 7 years. The prices announced today are based on these provisions. The Commission intends to continue the practice of extending annually, for 1 year, the period for which guaranteed prices of plutonium have been established so that the guaranty period will extend at least 6 years in advance at any one time.

In making such extensions, the Commission expects that the guaranteed fair price for plutonium will be reduced, as dictated by consideration of the value of the material for its intended use by the United States and giving such weight to the actual cost of producing it as the Commission finds to be equitable, to a level based upon the fuel value of plutonium in commercial power reactors.

The Commission action will facilitate the preparation of economic data required by regulatory bodies for nuclear power projects in the United States. In arranging financing and under ratemaking and stock issuance procedures generally applicable in the public utility field, complete public disclosure of anticipated and actual expenditures and revenues is required.

The principal application of the new price schedules will be in the power reactor field because research reactors generally do not produce substantial amounts of plutonium.

Mr. VANCE. That is correct.

Senator ANDERSON. So you are looking to what it is worth in commercial power reactors and not for weapons use.

Mr. VANCE. At the time this action was taken, Senator, there had been a year's elapse in the 7-year period for which the Commission has authorized the guaranty of a price. Therefore, it was legally possible for the Commission to extend its guaranties for 1 year more at that time. At the moment there was great concern expressed about the fact that we could not look ahead very far and be sure of how long we were going to need plutonium for weapons purposes. I presume it was one of those intervals, Senator, when Mr. Stassen was in London and we were all optimistic about what he would accomplish. As you know, optimism has fluctuated on this matter of controlling the further production of weapons, and it was decided at that time that in extending the guaranty for 1 year, it would be extended on the assumption that when that year rolled around, plutonium would have a value only for fuel purposes, and therefore it was set at $12. It was thought that it had a corollary advantage, and the corollary advantage was that in effect it put the industry on notice that weapons prices for plutonium were a very uncertain thing going back to what we discussed earlier this afternoon. I think this is right to the point. I think the extension for the seventh year on a $12 basis, rather than the preceding sliding scale or the $30, certainly was a notice to the industry that plutonium prices could not be maintained at weapons level indefinitely.

Chairman DURHAM. Are there any further questions?

Senator PASTORE. Mr. Chairman, may I turn back to a subject raised by Mr. Holifield? Do I understand this correctly, Mr. Diamond, that no patent thus far has been declared to be in the public interest? We are talking about nonmilitary uses; are we not?

Mr. DIAMOND. That is right. No patent has been declared to be affected by public use.

Senator PASTORE. Are you talking about since 1954 when the law was amended?

Mr. DIAMOND. That is correct, sir.

Senator PASTORE. That does not speak very well for the developments that have been made in this field; does it?

Mr. DIAMOND. This is an extremely reserve power that has been given to the Commission to declare private patents—patents that have been developed by private persons—to be affected with such public interest that the Commission ought to either use the patent itself or license others to use it.

Senator PASTORE. And no other individual has called upon the Commission to declare any such discovery as a moment of public interest?

Mr. DIAMOND. There has been one application by the owner of a patent to have the Commission declare his patent affected with the public interest, and we do not think this comes within the purview of the statute. If the Commission itself feels that a patent is affected with the public interest, it can so declare or it can do so if a third party would wish to use a patent of another person.

Senator PASTORE. No third party has asked so far?

Mr. DIAMOND. No.

Senator PASTORE. What does that indicate, Mr. Chairman, that we are going along pretty slowly in this field?

Mr. STRAUSS. I think one could draw several inferences that basic discoveries on which this whole art is founded were an accumulation over a considerable period of time. The things which were impounded in the war years and the years immediately thereafter were patents filed by individuals who were realizing upon the discoveries made in the preceding two decades. It may also mean that there has been a slackening of original approach. Another thing, one which I think contributes most to this effect, is the general atmosphere of declassification of information. There are many things, for example, which were thought to be evaluated as affected with the public interest until declassified within recent years. There are discoveries undoubtedly in those areas which are being patented daily. The large contractors, as you know, have an elaborate system in their laboratories whereby notebooks are kept by their scientists and discoveries are filed currently.

Senator PASTORE. This whole procedure expires on September 1, 1959; does it not?

Mr. STRAUSS. I do not recall the date.

Mr. DIAMOND. There is an expiration date. I think that is the right date.

Senator PASTORE. You will recall when we discussed the patent features of the amended law in 1954, there was so much apprehension on the part of the people as to the wide distribution of some of these new discoveries in the whole field of research and development.

Mr. STRAUSS. Yes.

Senator PASTORE. The question of the time limit came up so we thought we would put it down to September 1, 1959. I think that is correct.

Mr. DIAMOND. September 1, 1959.

Senator PASTORE. Which means after that date all the patents become exclusive anyway, and the power on the part of the Commission to declare any of these in the public interest will have expired on September 1, 1959.

Mr. STRAUSS. Unless previously extended; yes, sir.

Senator PASTORE. This does not go along to the discoveries that are made along the lines you have discussed with me, Mr. Chairman, but this goes along the lines of developments and discoveries with reference to reactors. Since we passed the law in 1954, permitting private industry to engage in this field, you say that there has not been any one discovery that would be in the public interest to have it declared such by the Commission.

Mr. STRAUSS. I would not say that, Mr. Chairman. I would say we are not aware of one.

Senator PASTORE. The fact that you do not know means that it did not happen.

Mr. STRAUSS. It may mean laxness on our part. I would not want to make the categorical statement that there are none such. I would rather have it stand that we know of none.

Senator PASTORE. Don't you think that is quite important, though, Mr. Chairman?

Mr. STRAUSS. I do.

Senator PASTORE. If you have some patent that is hanging around that should be declared in the public interest, unless you do it by September 1, 1959, you may be in bad shape.

Mr. STRAUSS. There we depend upon our patent staff to survey the field for us.

Senator PASTORE. I think it is quite necessary that be done immediately and not alone for that reason but merely as an enlightenment as to what progress has been made in this field. If in 5 years we have not developed any new idea that would really call for exercising this option in the public interest, then we have not gone very far.

Mr. STRAUSS. Is that a construction? There may be very many valuable patents and very extraordinary things that have been discovered, but whether they should be asserted to be clothed with the public interest to the extent that we withhold them is, I think, another judgment.

Senator PASTORE. No; that you can relicense them. I don't mean withhold them. You have no proprietary interest. The only thing you have is the right to declare in the public interest for the benefit of all. In other words, it loses its exclusiveness. Therefore by paying a certain fee another third party may have the benefit of that invention.

Mr. DIAMOND. And pay for its use.

Senator PASTORE. And apparently there have not been any developments so that anyone is clamoring for such advantage.

Mr. DIAMOND. It is quite possible that private arrangements have been worked out between parties.

Senator PASTORE. I wish we would get out of these possibilities. This is quite important. This is very, very important. If you do not know it, who would? I think the Commission ought to go into this. I realize it is a matter that requires some little research and time. Certainly someone ought to go into this and bring it up to date. What have been the developments, what are these patents, how many have been secured, who owns them, and why are we not interested in declaring them to the public use? I think that is very important.

Mr. DIAMOND. I would like to file the statement for the record.

Senator PASTORE. Yes; I wish you would.

(The information follows:)

The Commission's authority may be exercised over any patent at any time during its lifetime (17 years) for which application will have been filed prior to September 1, 1959 (sec. 153h), but not over any patent for which application has been filed thereafter.

The Commission has consistently followed its understanding that section 153 grants the Commission a power and authority which is properly to be held in reserve and to be exercised only under unusual circumstances. It is believed that Congress views the power and authority in the same manner; section 153a specifically and expressly requires that the invention or discovery covered by the patent must be of primary importance.

The exercise of the power is not necessary to the Commission's own utilization of patents owned by private parties, since, under the Court of Claims Act, title 35, United States Code, section 1498, as amended, the Government may use any invention or discovery covered by a privately owned patent, and the Government cannot be enjoined as respect its use of any patented invention or discovery, irrespective of section 153. The owner may, however, sue the Government in the Court of Claims, or claim compensation or award under section 157 of the Atomic Energy Act of 1954.

There has been only 1 request made to the Commission for the use of a patent which would have required the exercise of section 153 authority, and in this 1 case the applicant, being the owner, was not qualified to make such application. This, we believe, is explained in part by the fact that the number of private patents existing in the atomic-energy field prior to 1941–42 were very few, and that under Government sponsorship of the atomic-energy program from its inception until 1954 inventions and discoveries of Government employees and contractors became Government property. Since 1954 most major private activities have been in the areas of development and construction, and it is believed that most of these private activities utilize inventions and discoveries already owned by the Government. Thus, as previously reported in various Commission reports, some 1,400 patents owned by the Commission have been made available by the Commission on a nonexclusive license basis.

Another partial explaination may be that private persons may have made private contractual or other arrangements among themselves covering the use of privately owned patents. In this event, there would be no application to the Commission by the private party desiring to use the patent, and the matter might not even be brought to the Commission's attention.

Although no privately owned patents are presently deemed by the Commission as being of such primary importance, as to warrant the exercise of section 153 authority, rapid changes and technological advances may at some future date cause patents already in existence to be so deemed, and at that time warrant their being declared as affected with the public interest. For instance, the Fermi patent, No. 2,206,634, issued on July 2, 1940 (one of the few privately owned patents of the pre-Government-sponsored era) was not deemed of significance until after the atomic-energy program had been in existence for several years, at which time the patent was recognized as embracing a fundamental concept useful in the field in which the Government was working. The Government purchased the patent in November 1953, upon settlement of a claim arising under the 1946 Atomic Energy Act. The true value of other patents may likewise not become apparent or their primary importance recognized until some years hence in an unpredictable future.

Statistics indicate a significant and continuing increase in the number of patent applications filed anually in the atomic energy field by private industry. There were some 50 applications filed in 1954, 135 in 1955, 450 in 1956, and approximately 850 in 1957. It is of interest to note that less than 1 percent of private patent applications filed between August 1954 and January 1, 1958, have been placed under a secrecy order at the request of the Commission.

In conclusion, and in response to a question raised at the hearing as to the number of applications for patents filed since 1954, the British Patent Office by the United Kingdom Atomic Energy Authority, we regret that such information is not available to the Commission.

Representative HOLIFIELD. The gentleman from Rhode Island's clarity of thinking and explanation of the situation far excels my own effort to speak on the subject, but I would like to know how many patents have been filed by private people during this period of 4 years that this law has been in existence.

I would also like to know how many patents have been filed in England by the Government there to contrast its scrutiny of patentable inventions in comparison to our own. We have a little different incentive over there because the Government in England charges a royalty for the use of patents in the atomic energy field, while we in the true magnanimous American tradition give all of our patents to industry without any charge. If in addition to giving all of our patents that we had to industry without charge, if we are allowing

different sectors of industry to patent as a result of expenditures of the taxpayers' money, then we are allowing them to accumulate an equity at the point of discrimination of other groups who have not had the privilege of Government contracts. The whole theory of our patent law becomes a nullity. I am amazed to find out that there has not been even one patentable idea that has been thought to be worthy of scrutiny by the Atomic Energy Commission in 4 years. We have heard such rosy reports of our technological advancement. It does seem that there might be someone who had thought up an idea or technique or process or piece of hardware that was worth patenting in this field. I would like to have a full report on this.

Chairman DURHAM. Mr. Diamond, will you file a statement with the committee?

Mr. DIAMOND. Yes, sir; I will.

Chairman DURHAM. It is getting late. We have two more Commissioners to be heard. So the committee is adjourned until the morning at 10 o'clock, and we will meet in room 304, Old House Office Building.

(Thereupon, at 5 p. m., Wednesday, February 19, 1958, a recess was taken until Thursday, February 20, 1958, at 10 a. m., in room 304, Old House Office Building, Washington, D. C.)

24041—58——6

DEVELOPMENT, GROWTH, AND STATE OF THE ATOMIC ENERGY INDUSTRY

THURSDAY, FEBRUARY 20, 1958

CONGRESS OF THE UNITED STATES,
JOINT COMMITTEE ON ATOMIC ENERGY,
Washington, D. C.

The committee met, pursuant to recess, at 10 a. m., in room 304, Old House Office Building, Hon. Carl T. Durham (chairman of the committee) presiding.

Present: Representatives Durham, Holifield, Price, Dempsey, Van Zandt, Jenkins, and Hosmer; Senator Dworshak.

Also present: James T. Ramey, executive director; David R. Toll, staff counsel, George E. Brown, Jr., and Richard Smith, staff members, Joint Committee on Atomic Energy.

Chairman DURHAM. The committee will come to order.

I have to apologize this morning for the lack of space because this is the best we can do. It seems that every committee of Congress is holding hearings of some type or other and this is about the largest space we could secure for this morning. We have larger space for this afternoon's meeting.

This is continuation of the Joint Committee's meeting from yesterday, and I understand that Mr. Strauss, Chairman of the AEC, desires to make a statement at the opening of this meeting. You may proceed, Mr. Strauss.

STATEMENTS OF LEWIS L. STRAUSS, CHAIRMAN, UNITED STATES ATOMIC ENERGY COMMISSION; W. F. LIBBY, COMMISSIONER; HAROLD S. VANCE, COMMISSIONER; JOHN S. GRAHAM, COMMISSIONER; JOHN F. FLOBERG, COMMISSIONER; K. E. FIELDS, GENERAL MANAGER; EDWARD DIAMOND, ACTING GENERAL COUNSEL; HAROLD L. PRICE, DIRECTOR, DIVISION OF LICENSING AND REGULATION; CURTIS A. NELSON, DIRECTOR, DIVISION OF INSPECTION; EDWARD R. GARDNER, DIRECTOR, OFFICE OF SPECIAL PROJECTS; AND CLARK GOODMAN, ATOMIC ENERGY COMMISSION

Mr. STRAUSS. Thank you, Mr. Chairman.

This is just a brief correction and amplification of yesterday's record. I am sorry that Senator Anderson is not present to hear me, but he will have the benefit of the record.

Yesterday, in the course of the discussion of the raw materials program, Senator Anderson indicated that he was under the impression

that the decision which the Commission had reached in the matter which was being discussed by Mr. Jesse Johnson had been reached 2 weeks prior to the notification of the committee. Senator Anderson is quoted in the record as saying:

> The decision was reached 2 weeks before and we got the copies a day before.

In my response, I indicated that if this should prove to be the case, it was a slip, but that I would investigate it. The facts are as follows:

On October 23, 1957, the Commission approved a staff paper which contained a draft of Mr. Johnson's proposed speech before the Atomic Industrial Forum, in which this change in policy was announced. The meeting at which this occurred was the meeting at which this change of policy was approved, October 23. The Joint Committee was notified of it by a letter dated October 25, delivered by hand to the Joint Committee on that date.

Therefore, the impression that there was a 2 weeks' lapse is unfortunate, and I believe inaccurate.

Chairman DURHAM. Mr. Ramey wants to ask a question.

Mr. RAMEY. I think it would be desirable to check the record of the subcommittee hearing on raw materials on this point. This is purely a question of fact.

As I recall, there was testimony there that although this meeting of the Commission took place on the date that you mentioned, that there was a prior meeting at which the actual decision was reached on the policy, and that this speech was cleared on the date that you mentioned.

Mr. STRAUSS. There was no decision on policy prior to the meeting which I just mentioned. The minute which I have before me makes it clear.*

Representative VAN ZANDT. What is the subject, Mr. Chairman? I am sorry I am late.

Chairman DURHAM. Mr. Strauss is making a statement with regard to a statement made yesterday which had to do with disagreement as to dates.

Have you anything else to say?

Mr. STRAUSS. No.

I might say that the subject had been under discussion by the Commission for many months, going certainly as far back as February 1957. But the decision was made on the 23d of October and the Joint Committee was notified on the 25th of October.

Chairman DURHAM. That completes your statement?

Mr. STRAUSS. It does, sir.

Chairman DURHAM. Are there any questions by anyone of Mr. Strauss?

If not, we will proceed this morning with Commissioner Floberg.

Mr. Floberg, you may proceed.

Mr. FLOBERG. Thank you, Mr. Chairman.

I am going to present the portion of the Commission's report on United States industry in international atomic cooperation.

There are a few things which should be said about power and research reactors abroad and the part of American industry in supplying them.

---

*(For supplementary statement by Mr. Strauss concerning this point, see pp. 103–105 of these hearings.)

During 1957, five United States-built research reactors went into operation in Brazil, Denmark, Germany, Japan, and Netherlands. A sixth at Frankfort, Germany, went critical January 10, 1958, according to a press report. Counting the 2 power reactors on order, a total of 25 United States-built reactors were operating, being built, or had been contracted for by foreign nations. Orders for more were under active negotiation.

Most of these orders were made possible by our bilateral agreements which we have now concluded with 38 different countries and the city of West Berlin. Additional agreements now in the process of ratification will raise the number of cooperating nations to 43.

A very significant event in the field of international atomic cooperation was the creation of the International Atomic Energy Agency. In the first general conference of the Agency, work was completed on basic organization, on staffing and on a work program.

As you know, the former chairman of the Joint Committee on Atomic Energy, W. Sterling Cole, was elected as the first Director General of the Agency, an action which testifies not only to Mr. Cole's outstanding qualifications for this position, but also to world recognition of our country's initiative in establishing this Agency.

In one of the actions designed to support this new organization, the United States pledged 5,070 kilograms of uranium 235 to IAEA for use in peaceful atomic-energy projects sponsored by it. This total represents both the initial United States allocation of 5,000 kilograms of U–235 and the matching of tenders from the United Kingdom of 20 kilograms of U–235 and the Soviet Union of 50 kilograms of U–235. In addition, the United States matched Portugal's pledge of 100,000 kilograms of normal uranium oxide. The United States announced at the organization meeting that it would consider providing a research reactor and ancillary facilities to the IAEA.

To support the United States allocation of special nuclear material, the President increased the total amount of uranium 235 available for peaceful atomic-energy projects abroad from 20,200 to 50,000 kilograms. Of this total, approximately 35,000 kilograms has already been committed tentatively to be sold or leased as needed.

Our efforts to help in the promotion and construction of peaceful atomic-energy projects abroad are of great help in furthering our domestic programs.

The Commission's 23d Semiannual Report summarizes progress in all aspects of international cooperation, pages 189 to 221, and singles out progress in 1957.

In support of the efforts of United States manufacturers to sell their reactors abroad, the Commission has taken a number of steps designed to place United States manufacturers on the basis of equality with their competitors. In addition to the allocation of special nuclear material mentioned above, the Commission has also taken steps to assure that its services for reprocessing spent fuel elements would be available to foreign reactor owners on the same basis on which they have been offered to domestic reactor owners. The Commission has also offered to purchase plutonium produced in foreign reactors and is requesting legislation authorizing long-range commitments.

In the field of foreign credit, the Export-Import Bank has agreed to consider loan applications for the construction of nuclear powerplants on the same basis as conventional powerplants.

The Commission and the Department of State are actively seeking a solution to the problem of third-party liability in international trade in nuclear reactors. A résumé and copies of the Anderson-Price Act have been dispatched to all governments which have agreements for cooperation. Embassies abroad have been specifically requested to bring the United States' solution of this problem to the attention of appropriate foreign officials in order to stimulate thinking in this area.

The Commission is also exploring the effect thus far of the lack of foreign indemnity upon American industry seeking foreign reactor business, so that they may have a firm factual basis upon which to gage the present scope of the problem.

It is recognized that these and other steps have not solved or even identified all of the problems of United States industry in the foreign reactor market. The Commission is considering a number of approaches designed to strengthen the competitive position of the United States reactor industry abroad and, at the same time, advance the development of nuclear power here in this country. We are sanguine that the programs finally adopted will meet these objectives.

Chairman DURHAM. Does that complete your statement, Mr. Floberg?

Mr. FLOBERG. Yes, sir; it does.

Chairman DURHAM. I wish you would explain to the committee just how the operations actually work between you and the international representatives in the United States. Do you cooperate directly in these agreements with each country individually, or are you taking it up now through the International Agency first?

Mr. FLOBERG. You mean, Mr. Chairman, the countries with which we have bilateral agreements?

(Subsequently, at the request of the Joint Committee, the Commission submitted the following summary of bilateral agreements for cooperation:)

Division of International Affairs—Program Review and Analysis Branch—Status of agreements for cooperating as of Apr. 1, 1958

Cumulative number of countries	Country	Scope of exchange	Effective date
1	Argentina	Research	July 29, 1955
2	Australia	Research and power	May 28, 1957
3	Austria	Research	July 13, 1956
4	Belgium	Research and power	July 21, 1955
5	Brazil	Research	Aug. 3, 1955
6	Canada	Research and power	July 21, 1955
7	Chile	Research	Aug. 8, 1955
8	China, Republic of	do	July 18, 1955
9	Colombia	do	July 19, 1955
10	Cuba	do	Oct. 10, 1957
11	Denmark	do	July 25, 1955
12	Dominican Republic	do	Dec. 21, 1956
13	Ecuador	do	Feb. 6, 1958
14	France	Research and power	Nov. 20, 1956
15	Germany, Federal Republic of	do	Aug. 7, 1957
	Germany: City of West Berlin	Research	Aug. 1, 1957
16	Greece	do	Aug. 4, 1955
17	Guatemala	do	Apr. 22, 1957
18	Israel	do	July 12, 1955
19	Italy	do	July 28, 1955
20	Japan	do	Dec. 27, 1955
21	Korea, Republic of	do	Feb. 3, 1956
22	Lebanon	do	July 18, 1955
23	Netherlands	Research and power	Aug. 8, 1957
24	New Zealand	Research	Aug. 29, 1956
25	Nicaragua	do	Mar. 7, 1958
26	Norway	Research and power	June 10, 1957
27	Pakistan	Research	Aug. 11, 1955
28	Peru	do	Jan. 25, 1956
29	Philippines	do	July 27, 1955
30	Portugal	do	July 21, 1955
31	South Africa	Research and power	Aug. 22, 1957
32	Spain	do	Feb. 12, 1958
33	Sweden	Research	Jan. 18, 1956
34	Switzerland	do	July 18, 1955
	Switzerland	Power	Jan. 29, 1957
35	Thailand	Research	Mar. 13, 1956
36	Turkey	do	June 10, 1955
37	United Kingdom	Research and power	July 21, 1955
38	Uruguay	Research	Jan. 13, 1956
39	Venezuela	do	July 21, 1955

SIGNED AND IN RATIFICATION PROCESS AS OF APR. 1, 1958

Cumulative number of countries	Country	Scope of exchange	Date signed
(1)	Brazil	Power	July 21, 1957
40	Costa Rica	Research	May 18, 1956
41	Iran	do	Mar. 5, 1957
42	Iraq	do	June 7, 1957
43	Ireland	do	Mar. 16, 1956
(2)	Italy	Research and power	July 3, 1957
(2)	Peru	do	July 19, 1957

[1] Will be separate agreement.
[2] Will replace present research agreement.

SUMMARY.—In effect: 30 research and 11 power agreements with 39 countries. Signed: 4 research and 3 power agreements with 4 additional countries.
Apr. 1, 1958 (revised).

Chairman DURHAM. Yes. Where we have bilateral agreements and are going to furnish material to some of those countries. Do we go through the International Agency or do we go directly to the individual countries?

Mr. FLOBERG. We have been working directly with the individual countries, Mr. Chairman, in the negotiation of bilateral agreements.

Chairman DURHAM. I assume that is now the only way you could proceed on that basis. I am thinking about when you get going in full force in the international support of these reactors in the different countries in the way of furnishing fuel, and so forth. Are you going to deal directly through bilateral agreements all the way through, or are you going to deal some through the International Agency?

Mr. FLOBERG. I suppose history will evolve methods of procedure on this, Mr. Chairman. At the present time bilateral arrangements do call for certain fuel arrangements. At the same time, the International Agency will have materials available to it also, and I suppose that over a period of years there will be an evolution of systems that will possibly vary from country to country.

Chairman DURHAM. I asked the question because there was some concern in the minds of some members of the committee as to how much work the International Agency would be doing, with the bilateral agreements existing.

Mr. FLOBERG. There are certain functions that are particularly appropriate to the International Agency, such as the safeguards policing and the safety inspections and things of that sort.

I believe that it would be our desire to have the International Agency assume as much of the responsibility for those particular functions as was feasible, and as rapidly as it was practical.

It must be recognized, of course, that the International Agency is still in its swaddling clothes.

Chairman DURHAM. Are there any questions, Mr. Holifield?

Representative HOLIFIELD. In the first part of your statement, Mr. Floberg, you mention two power reactors on order. What are those reactors, who has them, and who has ordered them, and what size reactors are they?

Mr. FLOBERG. The two reactors are the Belgian reactor, a Westinghouse product, which is approximately 11,000 kilowatts, I believe, and the other is the Italian so-called Edison Volta reactor, which is also a Westinghouse product, rated I believe at 134,000 kilowatts.

Representative HOLIFIELD. Those are on order?

Mr. FLOBERG. They have been contracted for, Mr. Holifield.

Representative HOLIFIELD. Has the Edison Volta reactor project been firmed up?

Mr. FLOBERG. I believe it is in a letter of intent stage because there were three contingencies in the letter of intent that had to be satisfied. I believe it was a firm agreement based on those three contingencies. Whether they have been resolved to this point, I am not positive.

Representative HOLIFIELD. One of the contingencies is whether they would lease it or sell it?

Mr. FLOBERG. That is right. That is one of them. That has not been resolved. So the answer is that the contingencies have not been resolved.

Representative HOLIFIELD. Of the six research reactors that have been built, what size are they and what is their average cost? Are these university-type research reactors?

Mr. FLOBERG. Yes, sir; swimming-pool-type reactors.

Representative HOLIFIELD. They are in the nature of 100,000 or 300,000?

Mr. FLOBERG. Not kilowatts.

Representative HOLIFIELD. No, dollars.

Mr. FLOBERG. Closer to a million dollars, Mr. Holifield.

Representative HOLIFIELD. None of them are the small size like the Aerojet General type?

Mr. FLOBERG. No, sir; they are not that small. They are larger.

Representative HOLIFIELD. They are the university type?

Mr. FLOBERG. They are, generally speaking, in the 500-kilowatt class, Mr. Holifield, if you can call it a class by loose definition.

Representative HOLIFIELD. The 25 that you indicate there, the rest of these except for the 2 are the research type, is that right?

Mr. FLOBERG. Yes, sir.

Representative HOLIFIELD. Your reference of page 33 of your prepared statement to 22,200 kilograms being raised to 50,000 kilograms, is that a bookkeeping transaction? Is that a set-aside or a promissory amount?

Mr. FLOBERG. It is an earmarking.

Representative HOLIFIELD. It is an earmarking of an amount to be supplied in the future?

Mr. FLOBERG. Yes, sir. It is an availability allotment, really.

Representative HOLIFIELD. The 35,000 that has been committed tentatively, is there a firm commitment on 35,000 kilograms at the present time?

Mr. FLOBERG. No, sir; it is a tentative commitment. It is firm as far as planning is concerned, but it is not firm as far as the actual taking down of it is concerned.

Representative HOLIFIELD. If it is sold or leased it has to be sold on a commercial value basis, is that right?

Mr. FLOBERG. Yes, sir.

Representative HOLIFIELD. It cannot be given to them at a dollar a year or something like that. It has to be on the basis of the value received?

Mr. FLOBERG. There is certainly no plan to lease it for a dollar a year.

Representative HOLIFIELD. Does not the law require you to do it on a commercial value basis?

Mr. FLOBERG. If it does, then that answers the question.

Representative HOLIFIELD. On page 34 of your prepared statement, at the bottom, you stated that, in the field of foreign credit, the Export-Import Bank has agreed to consider loan applications for the construction of nuclear powerplants on the same basis as conventional powerplants.

Could you clarify that a little bit?

As a rule, conventional plants are economic and quite often the profit or the revenue they get for their product discharges the cost of the capital investment. Have the Export-Import Bank people accepted this on the basis of the conventional powerplant?

Mr. FLOBERG. This sentence, Mr. Holifield, refers to the fact that the Export-Import Bank recognizes the present state of development of the nuclear power art and is prepared to homogenize that with the state of development of the conventional power art. The credit in an Export-Import loan is the credit of the borrowing country, and the bank is prepared to extend credit to borrowing countries on the basis of a nuclear powerplant as if it were a conventional powerplant.

Representative HOLIFIELD. Providing the other part of the collateral is there?

Mr. FLOBERG. Provided the credit standing is strong; yes, sir.

Chairman DURHAM. Is that firm now in Italy as far as the Export-Import Bank is concerned?

Mr. STRAUSS. We have no definite information on that, Mr. Durham, or even as to whether any credit is being sought from the Export-Import Bank.

Chairman DURHAM. Negotiations were going on when we were in Rome between the Export-Import Bank and Italy.

Mr. STRAUSS. I understand that referred to another plant, not this one, but I may be wrong.

Mr. VANCE. The Edison-Volta people, Mr. Durham, advised us in December that they had completed their negotiations with the Export-Import Bank on all of the terms and conditions of a loan except the interest rate. That was the only thing that had not been concluded. The negotiated loans cover the American part of the total cost of the reactor; that is to say, the materials to be bought in this country, which represented 60 percent of the total estimated cost of the reactor.

Chairman DURHAM. As I recall, a the time we visited in Rome last fall, they were well pleased with the negotiations advancing as far as they had insofar as the Export-Import Bank was concerned. There is nobody here from the Export-Import Bank this morning.

Representative HOLIFIELD. In your statement, Mr. Floberg, you mention the problem of third-party liability and the fact that copies of the Price-Anderson bill have been dispatched to all the governments which have agreements for cooperation. Has that been with the hopes that those nations would adopt that type of legislation in those countries?

Mr. FLOBERG. This was a part of the background of this, Mr. Holifield. This was to call attention to the solution that had been resolved legislatively in this country and part of it was inspired by the motive that you point out and part of it is to emphasize the importance of the problem and the necessity for a solution.

Representative HOLIFIELD. Have you received any reports from governments abroad indicating that they have taken your subtle hint?

Mr. FLOBERG. I am informed we received no such reply.

Representative HOLIFIELD. It is a lack of enthusiasm on their part?

Mr. FLOBERG. I do not think it can be interpreted completely that way. I think time is necessary to solve these things, too.

Representative HOLIFIELD. That is all.

Chairman DURHAM. Since you are speaking to this foreign problem, what is the status now? Can you give us any information on Euratom and the progress that has been made? It is mentioned in your statement and that is why I ask that question.

Mr. FLOBERG. There have been further steps toward consolidation of Euratom's position in recent weeks. The agency has selected a president now. It is in the process of establishing headquarters. It is still in its early stages, of course, but it is now in business.

The president was scheduled to come over to this country this month, but he has been taken ill and I am not quite sure now what his scheduled arrival date is.

Chairman DURHAM. He was scheduled to come over?

Mr. FLOBERG. He was; yes, sir. I believe his illness has caused some change of plans, but that does not mean it is permanently canceled. It just means that it is postponed until he recovers, I am assuming.

Mr. RAMEY. Has Euratom selected a site for its headquarters?

Mr. FLOBERG. I believe not, although I do know this has been under active discussion within Euratom.

Mr. RAMEY. The committee was briefed somewhat this fall on alternate sites among the six coutries, with the general indication of Belgium, Luxembourg, or a smaller country.

Mr. FLOBERG. I believe the final decision has been postponed for something like six months. I think they are temporarily meeting in Belgium. But I believe this is a subject high on their agenda, as of necessity it must be.

Chairman DURHAM. You do not think their enthusiasm is less than what it was a year ago when they came over here so enthusiastically? When did they come over, last summer?

Mr. STRAUSS. Last spring.

Mr. VANCE. Just about a year ago.

Mr. FLOBERG. I certainly have heard nothing to indicate that, Mr. Chairman. On the contrary, it is my impression from what I have heard that their enthusiasm is on a high level.

Chairman DURHAM. Mr. Hosmer.

Representative HOSMER. I have no questions.

Chairman DURHAM. Mr. Holifield.

Representative HOLIFIELD. Mr. Chairman, I was not here yesterday at the beginning of the testimony, and there is one question I wanted to ask of Chairman Strauss' presentation.

At the bottom you say:

> After a thorough survey of atomic power development in the most advanced nations, this committee, known as the Three Wise Men, reported an impressive amount of research and development done both through the AEC and private industry has provided America with the most complete nuclear foundation in the world.

I wanted to make an inquiry as to how these three visitors were designated as the "Three Wise Men"? Who invented that title?

Mr. STRAUSS. I will disclaim any authorship. As a matter of fact, in the course of my remarks yesterday when I came to this I interpolated "popularly known as the three wise men." I did not invent it and I do not know the author.

Representative HOLIFIELD. Do any other members of the Commission know? This keeps recurring, and I would like to explore the background of this.

Is this a Madison Avenue slogan to bring great dignity and repute to these three people? I see it is continuously used and reused.

Mr. STRAUSS. Yes. I first heard it during the war, Mr. Holifield, as applied to three gentlemen representing the British Ministry of Munitions, who were here on a mission. As a matter of fact, Sir Edwin Plowden was one of them. I do not recall having heard it applied to a committee prior to that time or since, except in this instance.

Representative HOLIFIELD. The only three wise men I know anything about is the story about the three wise men from the East who visited the Christ child. I reread that the other night to find out what they did. They came for two purposes, as near as I could determine: To bring gifts and to pay homage.

Have these three wise men brought any gifts?

Mr. STRAUSS. I would say at this point, if you will permit me, that the reporter would be probably well advised to omit laughter from the record, but I will not be sensitive about it.

Representative HOLIFIELD. I am not either.

Mr. STRAUSS. It may well be that these three wise men have brought gifts, unaware of the fact that they were doing so. If Euratom realizes its purpose, which is to assist in unifying the free countries of Europe, it will be a great gift to the people of the United States and to the people of the world. I would be the last to discount it.

Representative HOLIFIELD. At least they bring homage.

Mr. STRAUSS. In their report, they do.

Chairman DURHAM. Are there any further questions?

If not, the next witness is Commissioner Graham.

Mr. Graham, I believe you are speaking on the subject of regulations and licensing. You may proceeed with your statement.

Mr. GRAHAM. Thank you, Mr. Chairman.

My presentation of this section of the report will be divided into two phases: The first, regulations and licensing; and the connected portion involving inspection.

I have here today with me Mr. Price, who will be able to assist me on any question specifically regarding regulations and licensing, and Mr. Nelson, with respect to inspection.

I will now begin, sir.

Chairman DURHAM. Very well, you may proceed.

Mr. GRAHAM. As indicated at last year's hearings, the Commission undertook a study to determine the best organization structure for the conduct of its regulatory responsibilities.

As a result of these studies, we have attempted to separate the licensing and regulatory functions in a Division of Licensing and Regulations, headed by Mr. Harold Price. Those promotional or nonregulatory functions which were in the Division of Civilian Application have been relocated in an Office of Industrial Development, to which Dr. Libby made reference in his testimony. Dr. Frank Pittman heads this office under the Assistant General Manager for Research and Development.

Continued growth in the civilian applications of atomic energy is indicated by the increased number of applications for licenses. This, of course, has in turn meant an increase in the licensing activities.

In 1957, there were applications for licenses to construct and operate 44 research and test reactors as compared to 19 in 1956 and approximately 3 times as many licenses to operate such facilities were

issued in 1957 as in 1956. Two applications for permits to construct large test reactors were set down for hearing at the end of 1957.

In the export field, United States firms applied for licenses to export 15 research and test reactors in 1957 as compared with 5 in the previous year.

In the power reactor field, a construction permit was issued to the Yankee Atomic Electric Co. after a public hearing, the first held in accordance with the requirements of the new Public Law No. 85–256. In addition, a license was issued to the General Electric Co. for the operation of the first privately financed nuclear powerplant.

In total, the Commission issued 22 permits to construct nuclear facilities in 1957, 5 amendments to construction permits, 34 licenses to operate nuclear facilities, and 18 amendments to operating licenses. In addition, 15 facility export licenses were issued and 3 amendments to such licenses.

Most of the licenses to construct and operate nuclear facilities and amendments thereto required detailed safety analysis by the staff, including meetings with the applicant. In those cases which were significant from a safety standpoint, the staff sought the advice of the Advisory Committee on Reactor Safeguards.

Normally, at the time of issuance of notice of intent to issue a construction permit or operating license or amendments thereto, a staff analysis is made available to the public.

With respect to facility export licenses, the primary determination is whether the facility falls within the agreement for cooperation between the United States and the country of destination. However, the Commission will provide technical assistance to the country of destination with respect to its analysis of the hazards of the particular facility. In 1957 we provided assistance in 13 cases.

During the past year, we also reviewed the safety of 38 projects either operated with and for the account of the Commission or operated by the DOD under Presidential directive. These included large scale power reactors such as the PWR project, and joint DOD-AEC projects such as the APPR, as well as various other Commission and DOD projects.

Operators' licenses were issued to 115 individuals during the year, bringing the total number of such licenses in effect at December 31, 1957, to 142.

In the materials fields, over 100 applications for special nuclear materials licenses were filed as against some 50 during 1956. The 80 or more licenses issued included uses for fuel elements development and fabrication, scrap recovery, production of fission counters, commercial analytical services, and various types of research.

Source material licenses issued totaled 1,982 as against 1,863 for 1956. At the close of 1957, there were 4,468 institutions and departments thereof which were licensed to use byproduct materials as compared with 3,664 a year ago. Appendix 7, pages 348 to 353, of the 23d semiannual report, details these activities.

In accordance with the amendment to the act, contained in Public Law 256, which was passed during the last session of Congress, the Commission is setting down for public hearing all cases involving applications for licenses to construct or operate nuclear powerplants or test reactors.

As the Joint Committee has previously been informed, the establishment of the basic regulatory framework was substantially completed in 1956.

In the field of insurance and indemnity, the most significant event of 1957 was the passage of the Price-Anderson Act. Within a few days of its passage, the Commission prepared and issued a temporary regulation, part 140, with the purpose of extending the benefits of the act to the public as soon as possible without imposing any undue, immediate requirements on the affected licensees. The regulation applies primarily to reactor operators and requires them to show adequate financial protection in amounts varying from $250,000 to $60 million, depending upon the size of the reactor involved. Beyond these amounts, the public is protected by the indemnity provided in this act.

The Commission is currently engaged in developing a permanent regulation in this field, which would, among other things, attempt to relate the amount of financial protection required of a licensee not merely to size of the facility involved, but to some of the other factors, such as location, which are mentioned in the act.

As required by the act, the Commission will submit to the Congress a separate and full report covering all developments in the indemnity field by April 1, 1958. Activities through last December are described in the 23d semiannual report, pages 177 to 179.

In the field of Federal-State relations, the Commission has continued to work closely with the States in assisting them, keeping them informed of our activities, and in seeking their advice.

The Commission considers it desirable to clarify the respective responsibilities at the Federal and State levels in the atomic-energy field. For this purpose, we still support the recommended legislation submitted to the Joint Committee in June 1957.

Mr. Chairman, that is the end of the part dealing with regulations and licensing, and if you wish me to stop there in case there are any questions before going to inspection, we could do it that way, or any way you suggest.

Chairman DURHAM. I believe we will proceed that way, Mr. Graham.

Are there any questions on this section of the paper?

Representative HOLIFIELD. I am very much interested in this, Mr. Chairman. We made a staff study in our Joint Committee of AEC procedures and organization in the licensing of reactor facilities. I suppose you have read that.

Mr. GRAHAM. I have read part of it, sir.

Representative HOLIFIELD. We suggested several ways of approaching this. Many of us have felt for a long time that it is very difficult to both promote and regulate. As the old saying goes, it is awfully hard to choke yourself.

In the field of regulations and the granting of licenses, it has seemed to some of us that this type of activity of the Commission should be completely separated and apart from the promotional and production part of the Commission's work.

I am glad to see a movement in that direction by setting up this new division. I guess it is not a division exactly; it is an office.

Mr. FIELDS. It is a division.

Representative HOLIFIELD. It is a division?

Mr. FIELDS. Yes.

Representative HOLIFIELD. I am glad to see you moving along that line. Could you give us a concept of how you are proceeding there?

What is your organizational setup within this Division? To what extent does it give the people in charge of it independence in arriving at regulatory decisions or in passing upon licenses?

What is your hearing examiner arrangement? Are they appointed from people within or from people without, as is the case at the present time in the PRDC hearing.

How have you got this Division set up? Would you explain it to us?

Mr. GRAHAM. Mr. Holifield, I think it would probably be more productivity if we ask Mr. Price, if he would, who heads that Division to tell you and the members of the Joint Committee exactly how it functions. I think it would probably be better.

So if I may ask Mr. Price to address himself to that point, I believe it would be more helpful.

Representative HOLIFIELD. Very well.

Mr. PRICE. The way we are set up, first on the question of hearing examiners, on the cases that go to hearing, the hearing examiner up to now we have borrowed from other agencies. They are completely divorced from any activities within the Commission.

We have two cases that are now set down for hearing that Mr. Graham mentioned. The hearing examiner will render an intermediate decision in those two cases, and then his intermediate decision will be final unless there is an appeal by one of the parties; that is, the applicant or one of the Commission staff, or unless the Commission decides they want to take it up anyway.

As far as the staff is concerned, the staff presented its position in those cases. The applicant presented his position. There were no interventions in those two. The hearing examiner's decision will be rendered. Then, whether it has to go any farther will depend on whether either party appeals to the Commission or whether the Commission under our rules decides that it wants to review it anyway.

In cases that do not go to hearing or do not automatically go to hearing, as test and power reactors are required to under the law, what we do there is this:

In the significant cases, cases that our Hazards Evaluation Branch, which is in my Division, think raise important safety questions, the cases are referred to the Advisory Committee on Reactor Safeguards. The power and test reactors are automatically referred to that Committee. We get the report of the Committee.

The staff of this Division of Licensing and Regulation then prepares a staff analysis dealing with the safety and any other questions that are raised.

Representative HOLIFIELD. May I ask, Do you have a full-time staff?

Mr. PRICE. Yes, sir.

Representative HOLIFIELD. They work on this in conjunction with other work for the Commission, or is this their full-time job?

Mr. PRICE. No, sir. It is their full-time job. It is the biggest branch in my Division, I believe, and they are full-time technical people having no responsibilities whatever except to review the safety

aspects of reactors. They have no other responsibilities for any other part of the Commission's work.

Of course, I do not, either. Nobody in my Division does. The Division is exclusively confined to dealing with regulatory matters and licensing cases that come up, plus, in the case of the Government reactors, such as Shippingport, and the production reactors, those cases for safety review are referred to our Division so that this Hazards Review Staff can examine them. There again, the important ones are referred to the Advisory Committee on Reactor Safeguards.

So, in the case of the Government-owned reactors, we have a separate, independent staff that has no responsibility for the conduct of the program, reviewing these cases from the standpoint of safety.

Chairman DURHAM. That applies also to all radioactive material which you license?

Mr. PRICE. The same thing goes for licenses issued for isotopes and for special nuclear material. Before the license is issued, technical people in the Division of Licensing and Regulations make a prelicensing evaluation to see that proper safety conditions are imposed in the license. The isotopes Licensing Branch has thirty-odd people in it, and they include technically trained people in this field.

We have a group of technical people who are radiation safety people who examine the special nuclear materials cases for criticality, and for radiation hazards that might affect safety.

All of this safety examinations with respect to licensed activities, whether it is reactors, fuel-element plants, isotopes, special nuclear materials, all of that review is done in this Division by people that have no program responsibilities in connection with the other work of the Commission.

Chairman DURHAM. Where would our responsibility end in furnishing U–235 to one of these foreign reactors as far as safety is concerned?

Mr. PRICE. This has been a difficult one for us to come to a sound position on and I am not yet sure we have reached the right answer. What we do in the case of export licenses for these research reactors that have been exported is that, on request, this hazard-evaluation staff that I mentioned consults with the technical representatives of the foreign government involved to advise them of how we go about the problems of safety evaluation for reactors in this country, and they actually go over the particular cases, pointing out problems that we think the foreign government might want to look into.

We do not attempt to issue a certificate of safety in the case of the export licenses, simply because we do not have the control over the people, control over the operation, and the procedures of operation that we do in this country. But we do furnish an advisory service on requests to the representatives of the foreign government.

Chairman DURHAM. I was thinking about the responsibility as far as lease of the material is concerned, which would still be our property. Has there been any determination as to whether or not that material still belongs to the Federal Government of the United States and that we are responsible for any hazards that it might cause?

Mr. DIAMOND. Mr. Durham, under our bilateral agreements—as a matter of fact, I know—we are indemnified and held harmless by the foreign government with respect to any accidents that might occur

through the use of this material. This is an indemnity that runs to the United States.

Chairman DURHAM. That is carried in the bilateral agreements?

Mr. DIAMOND. That is correct, sir.

Representative HOLIFIELD. On the use of examiners where a hearing is required, is it your custom to call independent examiners such as the other administrative regulatory bodies do from an outside panel, or do you have examiners from within your own organization?

Mr. PRICE. We do not yet have any examiners within our own organization. I believe we are planning to, sir. Up to now, we have borrowed examiners from the other agencies.

The usual practice of the other agencies, as I understand it, is to have examiners hired by the agency to handle the agency's work.

Representative HOLIFIELD. This is the plan you plan to follow?

Mr. PRICE. I believe that is the plan; yes, sir. They do have to be hired, you understand, from the civil-service register of qualified examiners.

Representative HOLIFIELD. You feel that will give them enough independence to function and exercise their own independent judgment without any type of influence from above, or coercion?

Mr. DIAMOND. Mr. Holifield, the Administrative Procedures Act defines the role of the examiner, and we are subject to the Administrative Procedures Act, so there is no question at all as to the independence of the examiners.

Representative HOLIFIELD. That is really the point I wanted to bring out, because the other examiners of other agencies do operate under that act. I wondered if this was the same setup.

Mr. DIAMOND. Yes, sir.

Representative HOLIFIELD. I think you are proceeding along the right line. I am not so sure that this function of licensing and regulating is not going to get so big that it may require a splitoff from the Commission. Of course, the independence of the operation of these examiners and the method by which their recommendations—I think you could hardly call it a decision—to the Commission are handled in the future will be very important.

Mr. PRICE. No, sir. Under our rules of practice, their decision is final unless there is an appeal by one of the parties to the five Commissioners, or unless the Commission on its own motion brings the case up for consideration.

Representative HOLIFIELD. I recognize that. With those two qualifications, it, in effect, does become a recommendation, because it is subject to veto.

Mr. FLOBERG. Mr. Holifield, the way a typical examiner's initial decision concludes is with a paragraph something like "This decision will become final in 10 days" or some other number of days, unless appropriate action is taken by one of the parties such as the filing of exceptions thereto, before the full Commission.

Representative HOLIFIELD. I think it has to be that way. I am not criticizing that point of it. I think it has to follow that procedure as long as it is within the agency itself.

Mr. FLOBERG. Let me assure you of one thing. I have had a little experience in practicing administrative law in Washington here. One of the things I am particularly sensitive to is the complete inde-

pendence of the trial examiners. As long as I have anything to do with this Commission, our trial examiners will be the most independent of any agency in Washington.

Representative HOLIFIELD. Their decisions, if you wish to call them that, will be matters of public record?

Mr. FLOBERG. Yes, sir.

Representative HOLIFIELD. In every case they will be?

Mr. FLOBERG. Yes, sir.

Representative HOLIFIELD. That is all I have, Mr. Chairman.

Chairman DURHAM. Mr. Van Zandt.

Representative VAN ZANDT. Mr. Graham, in your statement, you say:

> At the close of 1957 there were 4,468 institutions and departments thereof which were licensed to use byproduct material as compared to 3,664 a year ago.

The word "institutions" attracts my attention. Does that mean industry also?

Mr. PRICE. Yes, sir, Mr. Van Zandt, that includes all the educational institutions, the hospitals, and the industrial and commercial companies, and it includes the departments of those companies where they were separately licensed.

Representative VAN ZANDT. I felt you meant the term "institutions" as including the laboratories of industries, and so forth.

Mr. PRICE. Yes, sir. I believe that is broken down somewhere in the semiannual report.

Representative VAN ZANDT. You state:

> In the field of Federal-State relations, the Commission has continued to work closely with the States in assisting them.

What percentage of our 48 States today are interested to the extent that they are in touch with the Commission and obtaining assistance?

Mr. PRICE. The extent of thier interest varies. I would say nearly all of them are interested, for example, in the sense when we were working with them through the Council of State Governments and the Governors Council on Legislative Proposals that we sent up here on Federal legislation, plus State legislative proposals. They had a meeting of the Council of State Governments last April in Chicago, attended by representatives of most of the States. The extent to which the States are active in connection with regulatory matters varies, and I would say it is a pretty small percentage at the present time.

I think roughly 10 States have adopted the model State law that the Council of State Governments recommended, which we worked with the council in developing.

Representative VAN ZANDT. And the remaining 38 are headed in the same direction?

Mr. PRICE. Generally, I think that is right.

Some of the States that have not adopted that model law are still extremely active in the field of radiation safety under authority that they already had, and have promulgated some regulations setting radiation standards. New York is one; I believe California is another one.

Representative VAN ZANDT. On page 41 of your paper, you state the delegation of inspection responsibility for byproduct and source

material licenses was completed in February 1957, and a General Inspection Guide was issued. Is that a Government document?

Mr. GRAHAM. Sir, we have not come to that at this moment. That is the inspection part. And the Chairman suggested that we break the regulatory and the inspection. So if we could defer your question until we could get to that, we can answer at that time.

Representative VAN ZANDT. Very well.

Let me ask one more question. Of all the applications for licenses that have been filed with you, how many have you had to turn down on account of hazards? In round figures; was it 10 percent?

Mr. PRICE. We have only issued, as shown here, a small number of licenses. I do not believe we have actually turned down any. Some of them have had a hard time getting the record to show that they were going to have adequate safety procedures and safety designs in effect, but we have not had a reactor application so far that we had to turn down.

(A subsequent letter amplifying Mr. Price's remarks follows:)

ATOMIC ENERGY COMMISSION,
Washington, D. C., March 27, 1958.

Mr. JAMES T. RAMEY,
Executive Director, Joint Committee on Atomic Energy,
Congress of the United States.

DEAR MR. RAMEY: During the course of Mr. Graham's testimony before the Joint Committee on February 20, Mr. Van Zandt raised a question concerning the number of license applications which we have turned down on account of hazards. Since my answer related only to the number of facility-license cases turned down for reasons of hazards, I feel that some amplification of my answer might be desirable and offer the following information for possible insertion into the record.

The following is a breakdown of those cases in which an application for a license was requested and with respect to which the record has been closed without the issuance of a license:

A. Facilities:
1. One application was denied without prejudice upon request by the applicant.
2. Two applications were withdrawn by the applicant.

B. Operators' licenses:
1. One application was denied because the individual failed an operating test.

C. Special nuclear materials:
1. One application was denied because the use of the material requested did not fall within the category of uses authorized by the act and regulations.

D. Source materials:
1. Three applications were denied because the use of the material requested did not fall within the category of uses authorized by the regulations.
2. One application was denied for health and safety reasons.

E. Byproduct materials:
1. Twenty-one applications were withdrawn by the applicant.
2. Thirty-six applications were denied without prejudice because the applicant failed to pursue his application.
3. Ten applications were denied because the applicant did not meet the health and safety standards contained in the regulations.
4. Thirty-four applications have been closed out, because the activities for which licenses were requested did not require licensing under the regulations.

It should be noted that in some additional cases applications for material licenses were denied in part either as to the use or quantity requested because

the applicant could not satisfy the Commission that he was qualified to safely handle certain materials in the quantities or for the uses requested. In addition, in many cases where applications have been granted, conditions have been imposed on the activities for which the license was requested to provide reasonable assurance that the health and safety of employees and the general public would not been endangered.

Sincerely yours,

H. L. PRICE,
Director, Division of Licensing and Regulation.

Representative VAN ZANDT. In other words, they had to meet certain requirements and they did.

Mr. PRICE. That is right.

Representative VAN ZANDT. That is all, Mr. Chairman.

Representative HOLIFIELD. Mr. Chairman, I have a question on this same field.

I believe you said that 10 States have adopted the model law which was, I believe, recommended at the Governors' Conference. Is that not right, Mr. Price?

Mr. PRICE. Yes, sir. I have a note here that I think will give me the names of those.

Representative HOLIFIELD. I have some figures which are not up to date that said that 16 additional States had adopted atomic-energy legislation but not of the standard of quality as the 10 States that adopted the model act.

Mr. PRICE. There are some other statutes that have been enacted and I would be surprised if there were 16. Of course, some of the States already had some general legislation on the books, and California is one of them, under which they could issue regulations dealing with radiation standards.

If I could supply for the record an analysis of this, I would be glad to.

Representative HOLIFIELD. I wish you would, because I think it will show that over 20 States have not passed any law at all along this line specifically for the handling of radioactive materials and waste. This was my last information on it.

(The information referred to follows:)

Summary of State legislation and regulations in atomic energy field

	Statutes			Regulations			Advisory Committee [4]
	Coordination Act [1]	Registration of Material	Other [2]	Broad [3]	Registration of Material	Brief [4]	
Alabama							X
Arizona, Coordination Act introduced in legislature, 1958							
Arkansas, Coordination Act adopted in 1957	X					X	(X)
California, several statutes including one on disposal of radioactive materials. First State to have broad regulations			X	X			X
Colorado, regulation of broad scope requiring registration is under consideration						X	X
Connecticut, originally adopted New England Coordination Act which was broadened in 1957. Statute May 1957 authorized health department to promulgate regulations based on AEC's 10 CFR 20. Also 1957 statute on storage and transportation of hazardous materials	X		X	X	X		(X)
Delaware					X		X
Florida						X	X

See footnotes at end of table.

Summary of State legislation and regulations in atomic energy field—Continued

	Statutes			Regulations			Advisory Committee [5]
	Coordination Act [1]	Registration of Material	Other [2]	Broad [3]	Registration of Material	Brief [4]	
Georgia, Fulton and DeKalb Counties have brief regulation						X	(X)
Idaho							
Illinois, registration statute follows New York sanitary code		X				X	X
Indiana, hospital licensing requirements of board of health provide that radiation sources of all types in hospitals shall be used in accordance with AEC, 10 CFR 20						X	
Iowa							
Kansas, registration regulation under active consideration January 1958							X
Kentucky						X	X
Louisiana							X
Maine, originally adopted New England Coordination Act which was broadened in 1957	X						(X) [7]
Maryland						X	X
Massachusetts, a New England Coordination Act adopted August 1956. 1955 statute authorized department of health to promulgate regulation in draft stage. Study of regulation of radioactive materials extended through April 1958	X		X			X	(X)
Michigan, broad specification type regulation in draft form based on AEC, 10 CFR 20, NBS 61, ASA, and other States	X					X	X
Minnesota, 1957 statute authorizes department of health to draft regulations. Regulations will require registration when drafted			X				X
Mississippi, advisory committee on atomic energy established January 1958							X
Missouri							
Montana							
Nebraska							
Nevada							
New Hampshire, New England Coordination Act adopted 1955	X					X	(X)
New Jersey, Governor's Advisory Committee on Radiation Protection in November 1956 recommended comprehensive radiation protection regulations at State level						X	X
New Mexico							
New York, detailed regulations are set forth in the sanitary code and the industrial code. New York City also has regulations. Several bills introduced in January 1958. A bill to amend the general business law includes features of the Coordination of Atomic Development Act			X	X	X		X
North Carolina							X
North Dakota, brief registration statute adopted July 1957		X					
Ohio	X					X	(X)
Oklahoma							X
Oregon, July 1957 statute authorizes board of health to promulgate regulations after 2-year study			X				(X)
Pennsylvania, broad regulations based on NBS61 but includes some parts of AEC, 10 CFR 20				X	X		(X)
Rhode Island, Atomic Energy Commission established by legislature in 1955			X				(X)
South Carolina, New England Coordination Act adopted in 1956	X						(X)
South Dakota, statute similar to NBS 61 adopted March 1957 which includes registration requirement		X					
Tennessee	X						(X)
Texas, regulation adopted September 1956 taken from NBS 61				X	X		X
Utah						X	
Virginia							X

See footnotes at end of table.

Summary of State legislation and regulations in atomic energy field—Continued

	Statutes			Regulations			Advisory Committee[5]
	Coordination Act[1]	Registration of Material	Other[2]	Broad[3]	Registration of Material	Brief[4]	
Vermont							
Washington, Coordination Act adopted March 1957	X						X
West Virginia						X	X
Wisconsin, July 1957 statute authorizes counties of more than 500,000 to regulate air pollution including radioactive fractions or counterparts							X
Wyoming, Registration statute approved Feb. 19, 1955		X					

[1] Coordination Act: An act recommended to the States by the Council of State Governments. It is an extension of the New England Act which was recommended at the New England Governors' Conference in 1955.
[2] Other: Deal with other specifics, such as waste disposal, storage, or transportation.
[3] Broad: Regulations setting forth maximum permissible personnel limits of exposure, levels of radioactive content in air and water, waste disposal and registration, etc.
[4] Brief: Some mention of exposure limits, no registration.
[5] Advisory committee: Committees, commissions, or study groups formed by legislative or executive action to study the States' needs and role in an atomic energy program. Those formed by legislative action are designated (X).

Capsule summary of State activities

Number of States having:	
A. Coordination acts	9
B. Statutes (including coordination acts)	18
C. Coordinators	7
D. Registration:	
By statute	4
By regulation	5
Total	9
E. Regulations	22
F. Advisory groups:	
By legislative action	12
By executive action	22
Total	34

Representative HOLIFIELD. I think this brings up a very important question. We had before another subcommittee of which I am a member, the Subcommittee on Intergovernmental Operations of the House Committee on Government Operations, only 2 days ago, Secretary of the Treasury Anderson and former Gov. Lane Dwinnell, of New Hampshire, who are cochairmen of the executive group of the Council of Governors, who were considering this problem. We had before us their recommendation and in my opinion it was a real good recommendation.

Mr. PRICE. Is this the Federal-State committee that the President appointed?

Representative HOLIFIELD. Yes.

Mr. PRICE. We worked with their staff.

Representative HOLIFIELD. I went over their recommendations with great interest and I thought they were all directed along a very constructive line. However, it brought up this problem, which I think we cannot escape as a Federal entity, and that is the basic responsi-

bility for safety which is carried in the Atomic Energy Act of 1954, placing that responsibility for the safety of the people in the handling and use of this material on the Federal Government.

Mr. PRICE. We have accepted that in our regulatory program, and what we have proposed for the States would not amount to a relinquishment of any of our responsibilities at the present time, or any of our requirements.

What the States would do would be to act concurrently under these proposals with us.

At the present time our requirements cover the full scope of the safety matter.

Representative HOLIFIELD. I think this is the right procedure. I do not think that we can relinquish our responsibility to these States, and I would like to have the States discharge to the full, the police powers of the States in enforcing the standards. But as far as setting the standards is concerned, I think it is up to the Federal Government to set those standards and see that the States do it. I recognize we cannot force them to do it, but the question I am going to propound is this: If the States show, for any reason, a lack of diligence in promulgating State laws of inspection and safety in the handling of these materials, will the Commission accept the responsibility so far as they are concerned of refusing to ship into those States this dangerous material unless they are satisfied that it will be given proper safety inspection and regulation?

Mr. PRICE. Mr. Holifield, I can only answer what we are now doing and what the present legal and policy requirments are. We would not refuse to license the shipment of material into a State for that reason because we are satisfied that our regulations, which must be complied with, will achieve the necessary safety condition.

Representative HOLIFIELD. That is because you will follow in with Federal inspectors on the use of this?

Mr. PRICE. Yes, sir.

Representative HOLIFIELD. Wherever the States will accept the burden of inspection and regulation on standards supplied by the Federal Government, then you would curtail the actual Federal personnel going in and leave it up to the State, would you not, only as to the point of inspection to see that they are complying?

Mr. PRICE. Under the proposed legislation that we are submitting, that would be our plan.

Representative HOLIFIELD. Would that require inspection legislation by this committee?

Mr. PRICE. We have asked for legislation that would expressly recognize that the States have some jurisdiction. I do not know whether I can answer the tough legal question as to where the State stand absent that.

Representative HOLIFIELD. This, in effect, is enabling legislation which you ask for which would release you from the responsibility, providing the States come up with a certain standard of inspection and regulation?

Mr. PRICE. No, sir. It would merely let the States operate in the same area that we are operating insofar as safety standards are concerned, and it would permit us, as you say, in the States where we were satisfied that they had a good program, to curtail our inspection

activities in those States, but we would still keep our regulations on the books. We would still be responsible and would have to either inspect them directly or be satisfied with the State inspection.

Representative HOLIFIELD. Do you not think, if a State shows a lack of diligence in passing the necessary health and safety laws that the Federal Government could use the stick a little bit along with the carrot to obtain some action on the part of some of these legislatures of the States that are a little bit slow to recognize the tremendous impact of this question?

Mr. PRICE. Mr. Holifield, the problem is a little bit complicated by another factor. I do not know that there would be a great advantage in pushing the States to move into this regulatory field before they are ready.

Representative HOLIFIELD. Training?

Mr. PRICE. Yes. Technical people are hard to come by.

Representative HOLIFIELD. Yes.

Mr. PRICE. I do not know that we would help ourselves or the States at this time to take a position like that.

Representative HOLIFIELD. At least the Commission will continue to accept its responsibility fully in this field until they are satisfied that it can be delegated to the States?

Mr. PRICE. That is right.

Representative HOLIFIELD. I think that is very important. This incident at Houston which occurred has brought to the American people a kind of feeling of fear of the use of this material in industrial processes. Of course, none of us want an unnecessary and unfounded fear to exist. We want to be able to utilize this material and utilize it safely.

I am encouraged by your statement that the Commission will not delegate responsibility until they are sure that that delegation can be carried out.

Mr. PRICE. Yes, sir. I think I would have to say that neither we nor the States will assure that we will not have an occasional accident. I think we have to recognize that.

Representative HOLIFIELD. I know that.

That is all, Mr. Chairman.

Chairman DURHAM. Mr. Hosmer?

Representative HOSMER. No questions.

Chairman DURHAM. If there are no further questions on this part of the statement, you may proceed, Mr. Graham.

Mr. GRAHAM. Thank you.

Mr. Chairman, the second portion of my statement is the inspection portion.

Chairman DURHAM. You may proceed.

Mr. GRAHAM. In the establishment of a system for inspection of materials licenses the first major decision made was that the function would be decentralized to eight field offices to the maximum practical extent. The actual process of decentralization of the inspection function is proceeding in stages. Delegation of inspection responsibility for byproduct and source material licenses was completed in February of 1957, and a general inspection guide was issued, in preliminary form, to cover these functions. Our present schedule calls for decentralization of inspection responsibility for special nuclear material

licenses and issuance of an appropriate inspection guide in the very near future.

As of October 31, 1957, there were engaged in the inspection functions 30 professional personnel. As of the above date, also, approximately 1,150 inspections had been made and 1,075 reports had been received and processed.

Because of the complex problems involved in the inspection of production and utilization facilities, such inspections will be performed by the Washington headquarters of the Inspection Division. As of October 31, 1957, 40 inspections of facilities in various states of construction and operation have been conducted.

A second major decision was that inspection personnel must be knowledgeable and experienced in the handling of radioactive materials and control of radiation, and in the practical aspects of design, construction, and operation of reactors. We have been attempting to recruit people of high caliber in order to continue to evaluate safety hazards at the site, during actual operations.

Progress can be reported in our inspection program through assistance from the States of California, Connecticut, New Jersey, and New York. The measure of assistance can be expected to increase as the personnel of these States gain in experience and training. We are in touch with other States and we expect to work out similar arrangements with those who are able to render similar assistance.

That, sir, would conclude that portion of the inspection part.

This, Mr. Holifield, I think was covered somewhat in the discussion with Mr. Price. But, as I indicated earlier, and I do not believe Mr. Van Zandt was here at the time, we have Mr. Nelson here, who heads the Inspection Service, if there are any detailed questions you would like to ask.

I know, Mr. Van Zandt, you had one.

Chairman DURHAM. That does conclude your statement, Mr. Graham?

Mr. GRAHAM. Yes, sir.

Chairman DURHAM. I would like to say at this point that this is probably the first appearance before the public at large by the two new Commissioners, Mr. Floberg and Mr. Graham. I personally want to congratulate you on your fine statements this morning in your first appearance before the committee in public session.

Mr. GRAHAM. Thank you, Mr. Chairman.

Mr. FLOBERG. Thank you, Mr. Chairman.

Representative VAN ZANDT. Getting back to this inspection guide, would it be made available to all of those who have been granted a license?

Mr. NELSON. No, sir, the inspection guide is for the use of our own inspectors.

Representative VAN ZANDT. In regard to your inspectors, do they move around over the country? I am thinking now of the research reactor at Pennsylvania State University; do they make frequent visits?

Mr. NELSON. Yes, sir. Immediately npon the issuance of a construction permit our Division goes into action. We examine the construction from time to time, take a good look at it just prior to licensing and make recommendations to Mr. Price or the General Manager, and later we inspect during operation on a routine basis.

Representative VAN ZANDT. Have your inspectors found any violations of good procedure in the handling of this material to the extent it necessitated the closing down of the reactor?

Mr. NELSON. Not to that extent. We have found things that we thought posed a safety hazard and these have been corrected.

Representative VAN ZANDT. Has there been too many major accidents in the use of this material by non-Government groups? I am familiar with one in Long Island and another one in Houston, Tex.

Mr. NELSON. You are speaking of materials and not just reactors?

Representative VAN ZANDT. Yes, materials.

Mr. NELSON. There have been quite a number of what we call incidents, but the one you know of in Houston would represent about the worst type of material licensee accident we have had. Actually there have been few considering that there are over 6,500 licenses.

Representative VAN ZANDT. What is the general nature of the minor accidents to which you referred?

Mr. NELSON. Release of a minor amount of radiation in a laboratory, misplacing of a source, loss of a source. In a few instances minor exposures of personnel.

Representative VAN ZANDT. In your program of decentralization of inspection responsibility, eventually would it be possible to have an inspector in each of the States, or will you stick to a Federal program?

Mr. NELSON. You do not really need them, sir. There are so many States that have so few licenses, our field offices are distributed throughout the country, and each office finds it convenient to reach several States.

Representative VAN ZANDT. As the States develop the knowledge of the art, their inspectors can be depended upon?

Mr. NELSON. We are actively working, as Mr. Graham said, and we have reached an informal understanding with some States toward using the State inspectors if they have qualified technical personnel to do some of this inspection for us. We have to retain responsibility, of course, under the act, but if we can get them to assist us, we would save on personnel and avoid duplication of effort.

Chairman DURHAM. They are doing that type of training in many colleges at the present time.

Mr. NELSON. Yes, indeed, and we have offered to help train people for them by helping to defray training expense in postgraduate work.

Representative VAN ZANDT. What is the situation in Pennsylvania at the moment?

Mr. NELSON. Pennsylvania has an atomic energy act, I think, of some sort. We have not as yet sat down with them as we have with some other States and tried to definitize what they can do to help us or what we can do to help them, but we shall do this in the near future.

Chairman DURHAM. Mr. Holifield?

Representative HOLIFIELD. Maybe this question should be directed to Mr. Price rather than Mr. Nelson, but could you give us a brief report on the PRDC hearing, and what the status of it is at the present time?

Mr. PRICE. Mr. Holifield, I suppose the Commission could answer that better. It is before the Commission, as I understand, for decision.

Representative HOLIFIELD. The hearings and all other proceedings are completed?

Mr. DIAMOND. The record has been certified to the Commission by the examiner and the matter is now pending before the Commission.

Representative HOLIFIELD. Are there any plans for oral argument on it before the Commission, or any requests along that line?

Mr. DIAMOND. I am sure there will be oral argument allowed at some stage before final decision is made.

Representative HOLIFIELD. That is all, Mr. Chairman.

Chairman DURHAM. Mr. Hosmer.

Representative HOSMER. I have no questions.

Chairman DURHAM. Mr. Ramey?

Mr. RAMEY. On your decentralization of inspection responsibilities, do you have any plans for decentralizing inspections of reactors to your field offices?

Mr. NELSON. Yes; we do. They are some what long range in that we feel that we must have a fully qualified reactor expert, and these are not easy to find. But in a couple of field offices we have people who we think will develop into competent personnel for reactor inspection.

We would hope to widen the scope of this decentralization as time goes on.

Mr. RAMEY. That is all, Mr. Chairman.

Representative VAN ZANT. I have one more question, Mr. Chairman. I think this question should be directed to Admiral Strauss.

Admiral, do you have any information as to what England is doing in this field of inspection? Have they a similar organization?

Mr. STRAUSS. I think their problem, Mr. Van Zant, is a good deal simpler than ours because the area is very much smaller and it can be a very much more centralized operation. Otherwise, there has been a tendency there to pattern their organization upon ours simply, I presume, because ours has had a longer experience in the field and they have benefited by such mistakes as we have made. This applies, among other things, to the way they have recently reorganized their authority. But I do not have a detailed answer as to precisely how they manage this form of inspection.

I would be interested to know, myself, and when we find out we will report on it to the committee.

(The information referred to follows:)

ATOMIC ENERGY COMMISSION,
Washington, D. C., March 29, 1958.

Hon. CARL T. DURHAM,
Chairman, Joint Committee on Atomic Energy,
Congress of the United States.

DEAR MR. DURHAM: In answer to Mr. Van Zandt's inquiry during the 202 hearings, on the inspection system used in Great Britain, the following is submitted:

At the present time the United Kingdom Atomic Energy Authority is working with other Government agencies to develop legislation to be introduced into Parliament to regulate the atomic-energy industry in the United Kingdom. A large number of Government agencies and departments are involved and the distribution of responsibilities of each has not been determined. The Government components involved include the Ministry of Health, the Ministry of Transport, the Ministry of Labor and National Service, the Atomic Energy Authority and probably several others. The Prime Minister's Atomic Energy Office has overall coordinating responsibility. The proposed legislation is not expected to be ready for consideration by the present session of Parliament.

Although overall legislation is being developed at this time, some of the ministries mentioned above already are concerned with radiation problems, and have had for some time statutory rules and orders governing the health and safety of employees and the public.

After the conference on the health physics and biological implications of the windscale incident, held at Harwell on January 6 and 7, 1958, Mr. C. C. Palmiter of our Division of Inspection had the opportunity to meet with officials of the Ministry of Labor and National Service to discuss their inspection program.

The regulations and policies of this Ministry are in part formulated in the following documents:

1. Statutory Rules and Orders, 1947 No. 865 Factories. The Factories (Luminising) Special Regulations, 1947, dated May 7, 1947, made by the Minister of Labor and National Service under section 60 of the Factories Act, 1937 (1 Edw. 8 and 1 Geo. 6 C. 67).

2. Radioactive Substances Act, 1948, 11 and 12 Geo. 6 ch. 37.

The Ministry is also preparing other regulations to more adequately cover the industrial applications of atomic energy. An example of this is the factories (ionising radiations) special regulations, 1957. These regulations, although in draft form, apply to the uses of sealed radioactive sources by industry.

The Radioactive Substances Act of 1948 delegates the authority of control, regulation, and inspection to the various ministers concerned. In the case of industrial applications of atomic energy, with reactor-produced materials, naturally occurring radioactive materials, and X-ray fluoroscopy or crystallography, the Ministry of Labor and National Service is the Ministry responsible. This act allows the appropriate minister to make regulations governing the health and safety of employers, employees, and the general public with respect to occupations involving radioactive substances and irradiating apparatus. An advisory committee specified under the Radioactive Substances Act is consulted before any such regulations are prepared. In addition to this committee, an ad hoc expert committee and the Ministry of Labor and National Service Advisory Panel on Radiological Problems also are consulted when such regulations are made.

This Ministry has its headquarters at No. 19, St. James' Square, London. It is divided into 14 divisions which are made up of 100 districts covering the island, Scotland, Northern Ireland, and the Isle of Man. A staff of specialists is spread throughout the divisions to carry out radiation inspection functions along with other responsibilities of the Ministry.

The method of the inspector's operations, as related by Her Majesty's Deputy Chief Inspector of Factories, is as follows: The inspector, upon proper presentation of a duly authenticated document showing his authority, has the right to inspect any industrial facility in which radioactive materials are used. The inspector has the authority to recommend and require, on the spot, that the plant officials make changes in equipment, alter procedures, or take any action necessary to insure the health and radiation safety of plant personnel and the general public. The inspector also has the authority to close down an operation involving radioactive materials whenever an extreme hazard or unsafe operation exists.

If the plant officials refuse entry to the inspector, or if an offense is committed and the required action is not taken by the plant officials to correct the situation, the inspector may go to the nearest justice of the peace and swear out a warrant. In such cases, the inspector with the warrant and the aid of any constable may carry out his inspection or any other necessary action, by force if need be.

The inspection of the use of radioactive materials in hospitals is carried out by the National Health Service. Their health physicists or inspectors carry out a program similar to that of the Ministry of Labor and National Service. The Radiological Protection Service is available to the various ministries to conduct detailed surveys or radiochemical analyses. This service is used quite often by the inspectors.

This, in brief, is the extent of our knowledge concerning the inspection program carried on in the Unted Kingdom at the present time. As we gather more detailed information on their program we will be glad to inform you on such matters.

Sincerely yours,

LEWIS L. STRAUSS, *Chairman.*

Chairman DURHAM. Mr. Strauss, does that complete the Commissioner's statements?

Mr. STRAUSS. It does, Mr. Chairman.

Chairman DURHAM. I would like to make one observation here. We understand that the International Trade Fair will be held in Geneva next September, as announced at the time of the Geneva Conference which we attended 2 years ago, and the British reserved sixty to eighty thousand square feet of floor space as opposed to 40,000 for the French and we reserved only 20,000 for the United States.

What is the Commission doing to raise us at least on a level with the French and British?

Mr. STRAUSS. We can give you a detailed answer on that, Mr. Chairman.

This Geneva Conference to which you refer, which took place in the summer of 1955, is to a considerable extent the child of the Commission because we initiated it. We are particularly anxious not to do less well than we did in the summer of 1955.

There is here today Captain Gardner, who has been charged by the Commission with the preparations for our appearance and demonstration, and with your permission I will ask him to give a brief answer to your question.

Chairman DURHAM. Very well.

Mr. GARDNER. Mr. Chairman, I want to report that the Commission is cooperating directly with industry through the Atomic Industrial Forum in order to get greater participation by American industry in the United States exhibit. The United Kingdom has reserved some sixty to eighty thousand square feet of space in the downtown exhibition area. The French have reserved about 40,000. We have asked that 28,000 square feet of space be held for the United States. Of that, industry has taken about 17,000 to date. We hope that they will take more.

The Commission itself will have an exhibit in this area based on an exhibit developed around United States industry and Government relationships.

We have been working very closely with the Atomic Industrial Forum. I do not know whether there is a representative here from the forum or not.

Chairman DURHAM. Mr. Townsend, would you care to make a statement at this time?

STATEMENT OF OLIVER TOWNSEND, ASSISTANT MANAGER, ATOMIC INDUSTRIAL FORUM

Mr. TOWNSEND. All I can say is that the Atomic Industrial Forum, as Captain Gardner said, is attempting to coordinate the United States industrial exhibitors who are participating in the commercial exhibition in Geneva. We do think we will fill up, with the AEC exhibit, the 28,000 square feet which we think is well located in the exhibition area, and, at this time, we have full confidence that the United States will look appropriately good in the commercial exhibit at Geneva.

Chairman DURHAM. Do you think you can do as well with 28,000 feet as the British can with 80,000 feet?

Mr. TOWNSEND. I think the United States will look appropriately good in Geneva. The 28,000 square feet is well located, as I say, in the main exposition hall.

You have to remember that the British are much closer to Geneva than American exhibitors and the cost factor makes the United States space necessarily smaller than the United Kingdom.

Chairman DURHAM. Yes. The reason I raise this question is that people are concerned now in regard to another show, the World's Fair, which will open pretty soon. I had the pleasure of visiting there and looking at our space and across the street our competitor was building one twice the size. I do not know what he is going to have in it. The lack of personnel and lack of funds is a serious problem in the World's Fair.

I think international shows are very excellent things as well as some of these other things we do.

I might ask this, too, since Mr. Holifield suggested it. Have you any plans at all for the Brussels Fair?

Mr. STRAUSS. As a Commission?

Chairman DURHAM. Yes.

Mr. STRAUSS. We have been cooperating with the Director General of the American exhibit or the American participation there, but the commission itself, if I am correct, has no commission exhibit. We have provided some material. As a matter of fact, we have offered certain material which, for one reason or another, they could not accommodate.

Chairman DURHAM. Under the present conditions, according to the broadcast last night by the Director General, we are going to have to close our exhibit at 6 o'clock. Everybody else will stay open.

Mr. STRAUSS. This is based upon a shortage of appropriation and not upon the material.

Representative HOLIFIELD. Some of us are going to try to do something about that.

Mr. STRAUSS. It is so late in the day that one should move rapidly. I am very sympathetic with Mr. Cullman's predicament because he and his organization will be blamed by the unthinking for a situation for which he is not responsible at all.

Chairman DURHAM. He has done an excellent job. It is a beautiful building, good design, and well placed, and now he does not have the personnel to handle it. It should be done.

Representative HOLIFIELD. I was hoping if there is any way that the Commission could participate in that World's Fair—I just do not know what it would take, although probably it would take some appropriations—because I was tremendously impressed with this building we have there. To think of this building being dark about 40 percent of the time while the rest of the nations of the world, many of them who are in much poorer financial condition, are really putting on a show to the millions that will attend this fair seems to me a tragedy in the job we are trying to do to try to sell democratic institutions and ideas to the people of the world. I do not know just exactly what you need, Mr. Chairman, but I believe the committee would certainly feel like helping in any way we could if something could be worked out.

Mr. STRAUSS. I think, Mr. Chairman, acting upon the encouragement of Mr. Holifield that we will take a quick look—it will have to be quick—on what we might be able to do if we got some money to help them out, and in the event that we feel a contribution at this late date can be made, we will come back to you and ask for assistance.

(Supplementary information on the United States exhibit follows:)

Because of the lateness of the date, it is not practicable to enlarge the United States space allocation in the atom section in the science section or in the United State pavilion.

The Belgian Government has recently approved the installation and operation by the AEC of an aerojet AGN–211 research reactor in the science section. This will be an AEC contribution under the exchange of information program. The AEC has assisted the Commissioner-General's Office in preparing an exhibit for the United States pavilion by reviewing their plans, working closely with the designer, Becker and Becker Associates, over a period of many months, and has provided the following exhibits which are in addition to those obtained from industry or other sources:

1. Five bas relief models illustrating the following reactors:
   A. Pressurized water.
   B. Boiling water.
   C. Homogeneous.
   D. Sodium graphite.
   E. Fast breeder.
2. A model of the NS. *Savannah*.
3. One 1-inch cube of normal uranium metal which depicts energy equal to 12,000 pounds of coal.
4. One cube foot of orange oxide (U–308).
5. One glass ampule.
6. One simulated cobalt wafer.
7. Elecronic master slave manipulator.
8. Model of 72-inch bubble chamber.
9. Model of anti-proton-neutron experiment.

In addition, the United States AEC representatives are providing or are assisting in the following exhibits for the science section:

1. The free neutrino, LASL.
2. Applications of neutron diffraction, ORNL.
3. The effects of high energy radiation on solids, ORNL.
4. Photosynthesis—man's source of food, UCRL.
5. Diffusion cloud chamber, UCRL.

Mr. STRAUSS. The principal thing that we could do, which I dislike to mention here, was just simply not acceptable there for reasons that have nothing to do with either Mr. Cullman or ourselves.

Chairman DURHAM. I understand that.

Mr. STRAUSS. I have just a couple of matters which I would like to bring up.

Chairman DURHAM. I understand you would like to further amplify the statement you made at the beginning.

Mr. STRAUSS. Yes, sir, I would.

With reference to my remarks at the beginning of the session, I would like to add a statement in justice to Senator Anderson.

During this session the committee staff has provided me with a top-secret transcript of a hearing on January 20 in which a statement appears upon which the Senator may very well have based his belief that there was a lapse of 2 weeks between the taking of formal action by the Commission and notification to the Joint Committee. If he did, he would be well within his rights to think so.

I cannot read from the text of the transcript because it is top secret, but Mr. Johnson did indicate that the decision had antedated his speech by about 2 weeks.

A check of the record of the Commission, however, establishes the dates which I have given earlier, namely, that the Commission decision was taken on October 23, the Joint Committee notified on the 25th and the speech delivered on the 28th. But Senator Anderson is justified in having believed the facts to be as he stated them, based upon this testimony.

Chairman DURHAM. Has that been declassified?

Mr. RAMEY. That portion is unclassified.

Chairman DURHAM. You may read it if you care to.

Mr. STRAUSS. I might read it if you wish to have it read. This was a colloquy between Senator Anderson and Mr. Jesse C. Johnson, Director, Division of Raw Materials, AEC. It begins on page 67 of the record:

Senator ANDERSON. What about the question of keeping the committee fully and currently informed? When the Commission took its action upon this did it promptly tell the committee about it?

Mr. JOHNSON. It is my understanding that it did, yes, sir.

Mr. COOK. By letter and with a copy of the proposed speech prior to it being given.

Senator ANDERSON. When was the Commission meeting?

Mr. COOK. The date of the meeting?

Mr. JOHNSON. I cannot give the date. The 28th was on Monday and I know the date I gave that speech and I cannot forget that. The Commission cleared my speech on the prior Wednesday but it had received it some time earlier.

Senator ANDERSON. When did the Commission take its action, and it must have taken it some time earlier than that?

Mr. JOHNSON. The action on limiting procurement was taken about 2 weeks or so prior to that.

That is the statement, I think, on which the Senator bases his belief. But Mr. Johnson is wrong. I continue Mr. Johnson's statement:

At that time I was already scheduled to give a talk in New York and it was at my suggestion that the announcement was made there because as a result of the Commission action we had to make statements to the people who were coming in to us and seeking milling contracts and it seemed desirable to me that as early as possible, immediately, we should inform the uranium industry as to what the situation was.

Senator ANDERSON. Now, Mr. Cook, he says the decision was reached about 2 weeks ahead of the speech. When did the Commission tell the committee?

Mr. COOK. I would have to check it, sir, and I thought it was right soon after that.

Senator ANDERSON. One day before he delivered the speech so that it could not possibly get to any member of the committee.

Mr. COOK. I do not think so. It was delivered as quickly as we could.

Senator ANDERSON. If you found it was just 1 day ahead of the delivery of the speech, would you think that was currently and promptly informing us? It was done so we could not possibly know about it; was it not?

Mr. COOK. I don't think so. There was a Commission meeting on the Wednesday before the speech.

I think that covers it. The Commission met, as a matter of fact, on the 23d and at that time noted that the speech represented a reversal of past Commission policy and the record shows that I requested a copy of the speech be sent to the Joint Committee with the basic change pointed out.

Representative HOLIFIELD. I think the record would be incomplete unless we note that a copy of the speech and the notification of the speech arrived at the Joint Committee late on Friday afternoon before the speech in question was given on Monday. Our date and hour is October 25, which was a Friday, at 4:32 p. m. Of course, the next 2 days were Saturday and Sunday. The speech was delivered on Monday morning and released at 12 noon.

Mr. STRAUSS. Also, Mr. Chairman, your letter of January 17 with respect to these hearings asks specific comments on a number of topics. We have prepared such comments on all of them. Since two of these have been referred to in the testimony yesterday, I would suggest that they be inserted in the record at this point. They are the section on raw material base for the atomic-energy industry and scientific and technical manpower for the atomic-energy industry.

A third topic, controlled thermonuclear research, was embodied in the testimony which I gave on yesterday, and the other two topics relate to civilian power, and I suppose that they should be deferred until we appear before you on that subject.

Chairman DURHAM. That is correct.[1]

Mr. STRAUSS. May I offer these to the reporter?

Chairman DURHAM. Without objection, they will be inserted in the record.

(The documents referred to follow:)

RAW MATERIAL BASE FOR THE ATOMIC ENERGY INDUSTRY

From the beginning of the atomic-energy program, early in World War II, the availability of uranium was considered a possible limiting factor. During the years immediately following the establishment of the Atomic Energy Commission, we were faced with greatly increased uranium requirements and with limited sources upon which to draw. In fact, our whole atomic-energy program at that time depended upon 1 small mine in central Africa for more than 90 percent of our uranium supply.

The only known sources of substantial potentialities were domestic phosphate and shale deposits and South African gold tailings. Research was undertaken to develop processes for recovering uranium from these 3 sources. Because of their low grade, uranium from shale and phosphate deposits would be extremely high cost, from $30 to $50 a pound. The commercial phosphate industry offered possibilities for only small quantities of moderate cost by-product uranium. The South African gold tailings were the most attractive source for large-scale production at reasonable cost if an efficient process could be developed.

Additional sources had to be found, preferably sources that could be protected in time of war. However, no estimate could be made as to the time required for discovery, or the type of deposits that would be found, or where they would be found, if at all. Although a worldwide search was initiated, attention was concentrated on the United States and Canada. Both countries have vast areas favorable for mineral deposits. Experienced prospectors, geologists, and mining organizations could be counted upon to undertake an active search if an adequate incentive was provided. That incentive had to be a satisfactory uranium price.

Today, 10 years after the Commission initiated a comprehensive raw-materials program, uranium deliveries appear adequate for present military and power requirements, and production could be quickly increased if these requirements should be expanded. Thus, the Commission's decision of last October to limit contracting for additional domestic uranium concentrate marked the end of the initial "era of shortage" during which virtually the sole aim was to increase production.

[1] For concluding statements of AEC, see pp. 569–581.

In considering the Commission's recent decision, it might be well to look at the principal developments, in chronological order, responsible for the current favorable uranium position with respect to military requirements and the immediate needs of the power-development program.

(*a*) 1948–51: Development of an economic process for recovering uranium from South African gold tailings and the initiation of a major production program.

(*b*) 1948–53: Gradual expansion of United States and Canadian production as a result of new discoveries.

(*c*) 1953–55: Discovery and development of the Blind River field in Ontario, Canada, which now is one of the major uranium fields of the world.

(*d*) 1953–55: Development of extensive ore reserves in the Moab district, Utah, and the Grants area of New Mexico, with projects for greatly increased domestic production.

(*e*) 1955–57: Discovery and development of the Ambrosia Lake field in the Grants area, New Mexico. This development resulted in a major increase in domestic ore reserves and placed the United States in a leading position as a potential uranium producer. During the same period, but particularly in 1957, the Gas Hills-Crooks Gap district of Wyoming developed into another major uranium field. The favorable developments in New Mexico and Wyoming encouraged extensive exploration in other areas and some of these now show considerable promise.

It was the Blind River development that caused the Commission to take the first step to limit uranium procurement. This action, which limited our commitment for Canadian uranium, was taken early in 1955—before the development of the Ambrosia Lake, N. Mex., field or the Wyoming reserves.

From the beginning of the program, the Canadian Government had been urged to do everything possible to develop uranium production. In response to this request, the Canadian Government directly engaged in uranium development and production, and also established a program to encourage private exploration and development—a program patterned after the United States domestic uranium program. All Canadian uranium was committed to the United States except for quantities required by Canada for its own atomic project.

The Commission's other foreign uranium commitments, which are joint United States-United Kingdom commitments under Combined Development Agency contracts, also were limited or fixed in 1955 or earlier. As a result, a major discovery in Australia is being developed and brought into production for the sole account of the United Kingdom. Subsequently, as British requirements increased, the Commission released for sale to Britain substantial quantities of uranium which we had agreed to buy from Canada.

These actions were taken in the light of rapidly expanding domestic reserves and the need for an expanded domestic market to support continued exploration of our own resources.

Domestic developments since the beginning of 1955 have been most impressive. At the end of 1954, domestic ore reserves were estimated at 10 million tons; at the end of 1955, 25 million tons; at the end of 1956, 60 million tons; and today they are estimated at 75 million tons, but may be closer to 100 million tons of ore, or approximately 250,000 tons of U_3O_8.

Domestic concentrate production for the second 6 months of 1955 was 1,600 tons of U_3O_8, but at the end of the period was at an annual rate of 4,000 tons. Production for calendar year 1957 was 8,600 tons and is now at an annual rate of approximately 10,000 tons. A year from now, our annual production rate should be about 15,000 tons of U_3O_8 per year and, before the end of 1959, with full deliveries under all existing contracts, the rate may reach from 17,000 to 18,000 tons.

Thus, as already indicated, uranium deliveries under the Commission's present domestic and foreign commitments appear adequate for presently projected military and power requirements. Furthermore, we are in the fortunate position of being able to expand substantially domestic production in case of a sudden increase in requirements. Canadian production also could be expandid. Consequently, it would be undesirable from the standpoint of both the industry and the Government to expand uranium production beyond currently foreseen requirements and then be faced with a major curtailment prior to the development of a substantial market for industrial atomic power. The objective should be to have a strong uranium industry, with substantial reserves, capable of expanding to meet the requirements for atomic power as these requirements develop.

As shown by the preceding discussion, this is the situation as it now exists.

In view of these circumstances, the Commission decided to limit its procurement to the approximate level which will be reached as a result of existing commitments.

This decision is not without problems. The principal problem relates to those who already have developed ore reserves at substantial expense and may require a market, or an expanded market, in order to obtain a reasonable return on these expenditures. Also, there are those who have made geological investigations and commitments for mineral rights. We have been studying all of the uranium districts of our Western States to determine the nature and magnitude of the problems. Within established procurement limits, it will be the Commission's objective to relieve or ease these problems to the extent possible.

This reference to the current problem should not create the impression that we have too much uranium. The immediate objective is to keep production and requirements in reasonable balance. We intend to review the situation at least semiannually to this end. But the long-range problem is to develop additional ore reserves for our future requirements. This country's present estimated ore reserves of 75 million tons, or 200,000 tons of U_3O_8 which represents a little better than a 10-year supply of U_3O_8 at the estimated 1960 domestic production rate. We now lead the world in uranium production but we cannot maintain this position without aggressive exploration and development. In considering the rapid expansion of ore reserves during the past 3 years, the importance of one small area should be emphasized. If we eliminate an area within approximately 30 miles of the town of Grants, N. Mex., we would have only about a 3-year ore supply at the estimated 1959 production rate. There is no guaranty that areas of similar importance will be found. We certainly are not safe in projecting ore reserves on the basis of the past 3 years' experience. We also should consider another factor—rarely in the history of mining has the search for a metal been so intensive and widespread as that for uranium. That search will continue only as long as there is a favorable outlook for the uranium market.

Thus, in summary, today's ore reserves are impressive when compared with our improverished condition of the past. They are not impressive, however, if we accept some of the estimates of requirements for the industrial atomic power program as projected for 1970 to 1980. Known free world uranium reserves of the type now considered economic, are decidedly meager considering the plans being developed for atomic power which will involve many billions of dollars for capital investment and which are considered essential to the industrial and economic life of many of the nations of the free world.

These problems with respect to both the present and the future must be considered in relation to the cost and in relation to existing obligations and commitments. We are optimistic about the future for uranium. There has been no cutback in domestic procurement. On the contrary, a major expansion of mining and milling facilities is now underway as a result of concentrate contracts negotiated over the past year. However, we must face the fact that further expansion must be related to the growth of the industrial market.

Scientific and Technical Manpower for the Atomic Energy Industry

To maintain United States eminence in science and technology there is continuing need for aggressive programs which result in a steady increase in the number of scientists and engineers. While the Commission's responsibilities encompass only a fraction of the overall national problem in this area, during the past few years it has continuously increased its efforts to avert a threatened shortage of technical personnel in its sphere.

Four separate surveys have been undertaken by the Commission to determine with greater exactitude the national needs for scientists and engineers in atomic-energy programs. Two of these have been completed—one covering Commission and contractor operations, and another covering private industry. A third, dealing with academic requirements, has produced some useful preliminary estimates. The fourth, the evaluation of Federal requirements other than those of the Commission, remains to be completed.

On the basis of these surveys, the following estimates of 1957 total employment of scientists and engineers in atomic-energy programs have been made: for industry, about 9,000 engineers and scientists; for Commission contractors, a little more about 22,100; for academic institutions, about 4,300; and for Federal

employees of the Commission, slightly under 1,500. Together, these total nearly 37,000. Most of these, of course, were educated in science, or engineering, or mathematics. Some also had extensive training in nuclear aspects of science and engineering. In spite of a considerable expansion of employment in 1957 as compared with 1956—an increase of about 16 percent—the concerted national effort so far has prevented any critical shortage.

Continued annual increases are expected in the future. The Commission's survey indicated that privately supported industry was then anticipating that its needs will rise more than 70 percent, to a total of 16,000 during the next 3 years. Cooperating nations will continue to call on this country's manpower and facilities.

Although it is true that at present no critical shortage exists, our concern is that there will be sufficient numbers of technically competent individuals to permit further scientific advances and continued rapid growth of the atomic-energy industry. Lack of scientific manpower must not slow the progress of the industry.

The broad problem of training scientists and engineers goes beyond the scope of the nuclear matters which are of particular primacy in these hearings. Continued progress in nuclear fields, however, is dependent on an increased national supply of people trained in the basic fields of science, engineering, and mathematics. With sound preparation in these disciplines, the large majority of technical people needed for atomic-energy progress do not require intensive training in nuclear sciences or engineering.

The Commission has underway a number of specific programs to aid in increasing the supply of trained manpower. These can be grouped under three principal headings:

(*a*) Introducing nuclear-energy technology into the curriculums of colleges and universities at both graduate and undergraduate levels.

(*b*) Attracting top-caliber students to the nuclear-energy fields, and

(*c*) Providing means to update the knowledge of mature scientists and engineers so that they can participate fully in this field.

Under the first heading, the educational activities of the Atomic Energy Commission have been designed primarily to help the academic institutions plan, develop, and establish graduate curriculums in nuclear science and engineering. The action has been two-pronged; we help the schools acquire special equipment and materials, and we help them train faculty.

Under our equipment and materials assistance program, schools have been able to obtaining training reactors, subcritical assemblies, radiochemistry equipment, heat-transfer equipment, other laboratory equipment and specialized materials. With the mounting costs of education, many of these programs would have been delayed several years without AEC support. Let me assure you that AEC funds represent only a fraction of the total investment. The schools themselves, the States, and local industry have also made very substantial contributions.

Sixty-eight institutions have received equipment and materials grants from the AEC totaling about $6¾ million. In a separate program, 21 educational institutions have received grants during 1957 totaling $340,000 for specialized equipment for training courses in radiation biology and in the use of radioisotopes. In addition to the cash grants, source and special nuclear materials have been loaned without cost to 42 colleges and universities. Subcritical assemblies have been completed or are underway at 28 schools. Nineteen colleges have built or are acquiring nuclear reactors. Four have benefited from the Commission's program, adopted in 1955, to furnish nuclear fuel and provide for the fabrication of fuel elements for research reactors. In all, more than 80 different institutions have received aid of these types.

Although undertaken primarily to support needed research by qualified scientists, the research programs conducted for the Commission by universities and colleges have assisted the schools themselves in introducing nuclear technology into their curricula, and in providing student training by making research instruments and facilities available. Each year some 3,000 graduate students receive valuable experience through participation on projects of this type.

The Commission currently has in force nearly 900 contracts for research in universities and other nonprofit institutions in the physical and life sciences. Such research programs involve approximately 2,300 scientists and 1,700 graduate students who, in effect, received training while working for advanced degrees. The research conducted by these graduate students serves to help meet the requirements for their advanced degree thesis.

Our program of faculty training is based on the judgment that a competent staff is a factor even more important than equipment in putting the colleges and universities in a position to offer graduate programs in nuclear science and engineering. We must first train those who are to teach others.

Summer training institutes are now being offered which provide opportunities for those faculty members needing basic nuclear instruction as well as for those who require advanced work in chemical processing, reactor physics, nuclear metallurgy, or instrumentation and control. Initially conducted at Commission sites, most of these institutes are now presented on university campuses in cooperation with one of our national laboratories. Some 170 engineering and science faculty members, representing 72 colleges and universities, were given such training at the 1956 and 1957 institutes. In addition, the Commission has stimulated interest and provided knowledge regarding this new field through a vigorous program of lectures, symposiums, and conferences. For example, the Oak Ridge Institute of Nuclear Studies (ORINS), under contract with the Commission, administers a lecture program under which scientists, drawn principally from the Oak Ridge National Laboratory, are scheduled to speak at colleges and universities throughout the country. In the school year 1956–57 there were 177 such lectures presented. Since 1954 ORINS has also carried out an active program of regional and topical symposiums for college and high-school faculties and students, four of which were held in 1957.

During 1957, 41 staff members from Commission installations gave special lectures in biology. Consultations with students were included in these programs. In August a committee was established to advise the Commission on educational and training programs in the field of biology and medicine.

Under the second heading—attracting top caliber students for study—the Commission's principal activity is a broad program of scholarships, with the lecture and symposia programs previously mentioned also an important element. The competition for outstanding science and engineering students at the graduate level is well known. The overwhelming majority of better students desiring to do postgraduate work receive substantial support in the form of fellowships, teaching assistantships or research assistantships offered by many different organizations. If the atomic energy industry is to have a reasonable share of the very top students—the upper 5 percent—studying in the nuclear specialties, it must provide adequate incentives. Therefore, we support fellowships in fields of direct interest to the Commission—in nuclear science and engineering, in radiological physics, in industrial hygiene, and in industrial medicine. The program provided for 201 students this year.

In a different vein, the Commission stimulated interest of high-school students in science and engineering careers by showing of its traveling exhibits. Under a high-school demonstration program these exhibits have been shown to more than 710,000 pupils in 978 schools located in all 48 States and the District of Columbia. The doors of 11 Commission installations have been opened for group visits by high-school-science classes, and more than 4,400 pupils have taken advantage of this opportunity. More than 100 high-school teachers took summer institute courses in radiobiology and related fields in 1957.

The third category of Commission programs to increase the supply of trained manpower produces more immediate results by updating the knowledge of persons already trained in the basic professions. One such program involves Commission-operated schools. Until the colleges and universities are able to assume full responsibility for educational programs in nuclear science and engineering, the Commission has operated special schools at the graduate level; the Oak Ridge School of Reactor Technology (for Q-cleared United States nationals), and the International School of Nuclear Science and Engineering at Argonne National Laboratory (primarily for foreign students). The 2 schools have graduated almost 900 persons since their inception, including 217 from 41 foreign countries. Here the purpose is to provide mature engineers and scientists with special instruction in reactor technology and related fields. As academic institutions increased their competence in this area, the operation of both of these AEC schools was converted to function on a cooperative basis with selected universities. Only recently the college participation phase of ORSORT has been discontinued, partially because of the fine graduate programs in nuclear science and engineering that have been developed at our academic institutions. Special schools, such as ORSORT, can supplement and complement programs at colleges and universities but it is Commission policy not to compete with them. As a result, changes in school operation and curricula are always under review to determine to what extent they satisfy our specific needs.

Another means of updating the knowledge of persons already having basic skills and knowledge is through opportunities at AEC laboratories and production sites for graduate study and for outstanding students to do research which becomes the basis for advanced degrees. For example, graduate students may obtain work experience at Oak Ridge under a special arrangement with the Massachusetts Institute of Technology. Virtually all Commission contractors have cooperative arrangements with universities in their geographical area to provide study opportunities for their employees. In addition, summer-employment opportunities are available for both students and professors. Opportunities exist also for interested scientists and engineers to gain work experience at Commission research and production facilities. Specialized courses on radioisotope techniques and applications are offered at the Oak Ridge Institute of Nuclear Studies. All of these activities take advantage of the unique resources of the Atomic Energy Commission.

One final point. The statements one hears so frequently of the highly specialized training required of the scientist and engineer participating in nuclear programs have only a partial basis in fact. Most of those now working in the program have no specialized atomic-energy education, and many had little or no specialized atomic-energy experience. Private industry and the Atomic Energy Commission are largely dependent for nuclear work on scientists and engineers well trained in conventional disciplines who are capable of solving the problems within their field of training which arise in the atomic enterprise. Of course, there is a small but important percentage who do need long periods of specialized training. Such training is generally offered at the graduate level by our colleges and universities or can be acquired through work experience as the individual matures in his professional career. The important long-range need is to increase and accelerate the incorporation of new findings of nuclear technology into the applicable disciplines. By this means the student will become acquainted with the problems he will encounter and the techniques he will need in the nuclear environment of tomorrow.

Thus, through this three-pronged approach—assistance to enable colleges to introduce nuclear technology into their curriculums; efforts to attract students to scientific and negineering careers; and updating mature scientists and engineers—the Commission is endeavoring to do its part in helping the Nation meet its overall future needs for technical manpower. Meeting these total needs is the only sure way of assuring the reservoir of trained personnel the Nation will need in nuclear fields for the years to come. A more detailed presentation of the specific programs underway appears in the special section of the Commission's 23d semiannual report).

Chairman DURHAM. Thank you very much, Chairman Strauss and the Commissioners, for your statements.

I believe the next witness is Dr. McCullough, Chairman of the Advisory Committee on Reactor Safeguards.

Chairman DURHAM. Dr. McCullough, we are glad to have you with us this morning and you may proceed with your statement. You are to speak on reactor safeguards.

STATEMENTS OF DR. C. ROGERS McCULLOUGH, CHAIRMAN, ADVISORY COMMITTEE ON REACTOR SAFEGUARDS; DR. REUEL C. STRATTON, VICE CHAIRMAN; AND DR. ABEL WOLMAN

Mr. MCCULLOUGH. Mr. Chairman and members of the Joint Committee, in response to your invitation I am appearing before you to give a brief report on the functioning of the Advisory Committee on Reactor Safeguards which was created by the Indemnity Act, Public Law 85–256, on September 2, 1957.

Representative HOLIFIELD. Are you an employee of the Commission now or are you divorced from it?

Dr. MCCULLOUGH. I am not an employee of the Commission but members of the Committee have contracts for functioning as members of the Advisory Committee.

Representative HOLIFIELD. On a consulting basis?

Dr. MCCULLOUGH. Yes, sir.

Representative C. VAN ZANDT. With the Commission?

Dr. MCCULLOUGH. With the Commission; yes, sir.

Also here today are two other members of the Committee, Reuel C. Stratton, Vice Chairman, and Dr. Abel Wolman.

The Atomic Energy Commission has appointed the following persons to this statutory Committee: Dr. Manson Benedict, Dr. Harvey Brooks, Dr. Willard P. Conner, Jr., Dr. R. L. Doan, Dr. C. Rogers McCullough, Dr. Mark M. Mills, Mr. K. R. Osborn, Mr. D. A. Rogers, Mr. Reuel C. Stratton, Dr. Abel Wolman.

These individuals were all members of the Safeguards Committee which existed prior to the passage of the amendment.

Representative VAN ZANDT. Who appointed that Safety Committee?

Dr. MCCULLOUGH. The old Safeguard Committee was appointed by the General Manager of the Commission.

The Committee elected C. Rogers McCullough as Chairman and Reuel C. Stratton as Vice Chairman. Dr. Mark M. Mills has since found it necessary to resign because of the heavy demands of his position at the Radiation Laboratory, University of California.

In the fall of 1947, the problem of reactor safeguards was recognized by the appointment of a reactor safeguards committee consisting of outstanding scientists to advise the Commission with respect to reactors which were then all owned by the Atomic Energy Commission.

In 1951, an industrial committee on reactor location problems was created to survey certain environmental problems of reactors which had become apparent. This committee was made up of persons who were familiar with the control of severe hazards in the chemical process industries.

When it became evident there was an overlapping of responsibilities, the two committees were then merged to form the Advisory Committee on Reactor Safeguards in 1953. In the same year, this Committee recognized the problem and recommended a permanent full-time technical staff.

Later this group became the Hazards Evaluation Branch of what is now the Atomic Energy Commission Division of Licensing and Regulation. This Branch has provided the Committee with hazard analyses which have been of valuable assistance.

The general responsibilities of the Committee are set forth in section 29 of the Atomic Energy Act which provides:

> The Committee shall review safety studies and facility license applications referred to it and shall make reports thereon, shall advise the Commission with regard to the hazards of proposed or existing reactor facilities and the adequacy of proposed reactor safety standards, and shall perform other duties as the Commission may request.

And, section 182b, which provides:

> The Advisory Committee on Reactor Safeguards shall review each application under section 103 or 104b for a license for a facility, any application under section 104c for a testing facility, and any application under section 104a or c specifically referred to it by the Commission, and shall submit a report thereon, which shall be made part of the application and available to the public, except to the extent that security classification prevents disclosure.

The Committee believes, in the present state of the reactor art, it is impossible to set up rigid or fixed criteria or definite standards because the exercise of judgment and flexibility is needed during the developmental era. Each case presents differences which must be resolved individually.

Representative HOLIFIELD. Mr. Chairman, may I ask a question at that point?

Chairman DURHAM. Mr. Holifield.

Representative HOLIFIELD. I notice in the outline of sections, under section 1828, that there is left out of the law the construction license. I think this was brought out quite clearly in the PRDC case that they were permitted to go ahead on a construction license which did not fall under the licenses to operate, sections 103 and 104a. Are you going to in your statement, or will you comment, on whether you think that the construction license itself, of a reactor, should have a screening for potential hazard before the construction license is granted, or do you feel comfortable with the present arrangement where a construction license is granted to build a new type of reactor, the hazards of which have not yet been established?

That is kind of a complicated question and remark I have given you, but if you are going to comment on it in your statement or if you are going to comment on it separately, I would like to know.

Dr. MCCULLOUGH. I think it is not specifically covered in the statement. May I respond now?

Representative HOLIFIELD. After you finish your statement, if you wish.

Dr. MCCULLOUGH. All right. Shall I continue, sir?

Chairman DURHAM. Yes.

Dr. MCCULLOUGH. The committee realizes that its functions strictly in an advisory capacity. The committee, consisting of members who can only devote limited time to its work, cannot of itself make complete technical studies. It reviews designs and considers theoretical data but does not inspect the finished facility. On all of its work, the committee supplies reports to the Commission, some of which are for publication.

In performing its duties, the committee has reviewed certain research reactors, testing reactors, power reactors, and other high-output reactors.

By law the committee must review applications for licensed testing reactors and in order to differentiate these from research reactors, at present the following distinctions are being used.

If you recall test reactors must have a public hearing and research reactors are not so required. I would say these are recommendations by the committee and I don't wish to take any responsibility for them as regulations. These are really distinctions rather than definitions:

1. Any reactor producing 1 megawatt of thermal power or less will be considered a research reactor.

2. Any reactor producing over 10 megawatts of thermal power will be considered a testing reactor.

3. Reactors with thermal power levels between 1 megawatt up to and including 10 megawatts will be considered as—

(*a*) a research reactor when the core contains no experimental facilities;

(*b*) a testing reactor when the core contains spaces available for loops or large capsules or if experimental fuel assemblies may be inserted; or

(*c*) a testing reactor if the facility is a fluid fuel reactor having a thermal power capacity in excess of 1 megawatt.

It is recognized that these are somewhat arbitrary. The committee is leaning on the side of perhaps excessive review rather than under review.

Since its inception as a stautory committee it has considered 11 cases; 5 of these were licensed reactors upon which reports were required for publication. These were the Commonwealth Edison power reactor, GE test reactor, MIT research reactor, NACA test reactor, and the Yankee power reactor. The remaining six reactors did not require licenses or published reports.

The committee members are furnished the hazards summary reports and all other pertinent information prepared by the applicant, designer, constructor, operator, or owner as the case may be, and the reports of the Hazards Evaluation Branch of the Commission.

The committee members study these reports and review them at their meetings which are scheduled on a bimonthly basis with interim meetings when necessary. Because the committee believes strongly that direct contact with technical persons is essential for proper judgment of reactor hazard problems, it is the practice to have technical representatives of the applicant or other interested parties present at the committee meetings when the review is made. By interested parties, we do not mean public in the sense that they might appear in a public hearing. By interested parties we mean parties of the Commission or subcontractors or people of that sort.

Representative HOLIFIELD. This is an executive hearing you are speaking of?

Dr. MCCULLOUGH. These are executive meeting, sir.

Representative HOLIFIELD. These reports are not made public?

Dr. MCCULLOUGH. The minutes of these meetings are not made public; no, sir.

Representative HOLIFIELD. Would they be made public to an interested public member in case of a contest?

Dr. MCCULLOUGH. The reports that we render to the Commission in certain cases, the test and power cases, are made public by law. This is the report of the committee.

Representative HOLIFIELD. This is the high thermal operating reactors or test facilities?

Dr. MCCULLOUGH. Yes, sir. Testing facilities, power reactors.

Mr. RAMEY. How are those reports made public?

Dr. MCCULLOUGH. Sir?

Mr. RAMEY. In what manner are they made public?

Dr. MCCULLOUGH. We submit our reports to the Chairman of the Commission, Admiral Strauss, and then they are published through the public document room by procedures of Mr. Price's Division of Licensing and Regulation.

Representative HOLIFIELD. Do they have the exercise of judgment as to whether they should be printed or not?

Dr. MCCULLOUGH. No, sir, we do not.

Representative HOLIFIELD. Do they? Does Mr. Price?

Dr. McCULLOUGH. In the case of the testing and power reactors these are required to be made a part of the public record by law.

Mr. RAMEY. Are the reports issued in the Commission's hazard report which they send out in the public report? Does your report accompany the Commission's hazard evaluation report?

Dr. McCULLOUGH. I am not too clear about the details of this, but this is my understanding. It is part of the public record.

Dr. STRATTON. As soon as our report is finished, it becomes a part of the application and therefore is public.

Chairman DURHAM. Mr. Toll.

Mr. TOLL. I believe the Commission issues a press release when it issues a construction permit and attaches to the press release the opinion of the Commission staff, that is, the hazards evaluation staff. Do they also attach the opinion of the Advisory Committee in those cases?

Dr. McCULLOUGH. I just dont know, sir.

Dr. STRATTON. That has happened in some case because I read it in the public press myself.

Representative HOLIFIELD. There is no one here from the Commission that could answer that question, is there Mr. Chairman?

Mr. GOODMAN. I am the Assistant Director for Technical Operations, Division of Reactor Developmnt. While I cannot speak directly to this point, in the past it has been customary to do this but I do not think the Commission considers it obligatory to do this at the present time.

I do not believe there is any regulation. Would that check with your understandings, Dr. McCullough?

Dr. McCULLOUGH. That is my understanding. There are cases where it has been released in this way but I am not at all sure of the policy or the system.

Representative HOLIFIELD. It seems to me that this is something that ought to be looked into and some information given to the committee because I could imagine a situation where a report might be given and if it is not obligatory that it be made public that it could be filed in the document room and not come to the eyesight of the committee or the public.

(The information referred to follows:)

With respect to those facility license cases required by law to be referred to the Advisory Committee on Reactor Safeguards for advice, the procedure to be followed in regard to publication of the committee's report is the procedure we used in the matter of general electric test reactor. The ACRS report and the detailed AEC staff analysis are placed in the Commission's public document room at the time in the matter is set down for hearing. The notice of hearing, which is published in the Federal Register, refers to the fact that these two documents are available in the Commission's document room. In addition, a press release is issued notifying the public that the matter has ben set down for hearing, and stating that the ACRS report and the detailed staff analysis are available in the document room. Further, copies of the notice of hearing, the ACRS report, and the detailed staff analysis are sent to the Joint Committee and the interested State agencies.

Similarly, with respect to other facility license cases referred to the ACRS for advice, the procedure to be followed is that which was followed in the amendment to the Commonwealth Edison construction permit. The ACRS report and the detailed staff analysis were placed in the public document room at the same time that the notice of proposed action was published in the Federal Register. The notice referred to the availability of the ACRS report and the staff analysis. Copies of the documents were sent to the Joint Committee and interested State

agencies. While in this particular case we did not issue a press release, since it only involved an amendment to the construction permit, we do plan in the future in all facility licensing cases referred to the ACRS for its advice to put out a press release informing the public of the proposed action and the availability of the ACRS report and detailed staff analysis.

We presently have under consideration the question of publication of reports of the ACRS and the detailed AEC staff analysis on facility cases exempt from licensing pursuant to section 110 of the Atomic Energy Act of 1954.

Chairman DURHAM. I do not see how that could happen. It is a statutory committee and the report would have to be made to the Joint Committee.

Representative HOLIFIELD. Am I in error on that assumption, Mr. Goodman?

Mr. GOODMAN. I am sorry, sir, I didn't hear your statement.

Representative HOLIFIELD. My statement was that under this type of arrangement it would seem that Mr. Price's division would have the latitude of judgment which he might exercise to prevent such an opinion of the Advisory Committee from becoming public.

Mr. GOODMAN. I will check into that and see. As it is now, the opinion goes directly from the Advisory Committee to the Chairman of the Commission. It may be transmitted bodily by Mr. Price but it is not actually filtered through Mr. Price's transmission system.

Chairman DURHAM. That was one of the reasons for making this committee a statutory committee under the act.

Dr. MCCULLOUGH. That is right. The committee's report goes directly to the chairman of the Commission.

Chairman DURHAM. Under the act he would have to report it to this committee. Whether or not it should be made public is a different question?

Mr. GOODMAN. That is right.

Dr. MCCULLOUGH. Sir, if I may clarify, the reason I seem to be ignorant of this is that our feeling has been that when we submit our report to the Chairman of the Commission that ends our responsibility about any further publication.

Representative HOLIFIELD. Yes. I am not criticizing your procedure at all. I was trying to follow through what happened after you made your recommendation. Mr. Ramey had a question.

Mr. RAMEY. Just for the record, I believe the Commission has been sending at least some of the reports to the committee. I know the NACA report was sent to the committee and others. Whether they are doing it as a routine or not is something we ought to address to the Commission. But there is a distinction between filing it in the public document room which is public notice and getting it available to the public as a part of a press release along with the Commission's Hazards Report which would have much wider dissemination and accomplish the purpose of public information.

Chairman DURHAM. This is one way we can educate the public on the safety of this. I believe the committee is so important to the public at large since this fear does exist in the minds of the people, it should be public.

You people are knowledgeable and I think your recommendations should be released as publicly as possible. That is, except for anything that violates security. I am just expressing my own opinion.

Representative HOLIFIELD. You may recall that because the Commission ignored a safety advisory committee's recommendation on a cer-

tain type of reactor that the committee felt it was necessary to create your body as a statutory body in order that your actions might be independent and also that the public might be protected by having access to such judgment as you might exercise.

Dr. McCULLOUGH. Mr. Goodman has offered to look into this matter and I will cooperate with him.

Chairman DURHAM. You may proceed, Doctor.

Dr. McCULLOUGH. Thank you, sir. I was talking about how we conduct ourselves at the meeting and I made the point that it is the practice to have the technical representatives of the applicant and other parties present at the committee meetings when the review is made.

The review includes questions and discussions. The committee uses staff assistance which includes personnel of the Atomic Energy Commission and staff of other Government agencies, such as the United States Weather Bureau and the United States Public Health Service.

The committee discusses the case in executive session and then writes its report in the form of a letter to the Chairman of the Atomic Energy Commission.

In the performance of its functions, the committee believes that it is important to keep informed about the actual experience with reactor operations. It maintains liaison with those responsible for the operation of the production reactors, test reactors, and military reactors.

In particular it expects to be kept informed about any mis-operations or malfunctions of reactors and reviews these experiences either by oral or written reports.

The committee encourages the Commission to continue research work in reactor safety and, in particular, work with test reactors and assemblies at remote sites to determine actual effects of reactor excursions, malfunctions, and runaways.

Representative HOLIFIELD. If something does occur in the way of an incident, do you feel obliged to convene some members of your committee or one member of the committee and go and actually look at the incident?

Dr. McCULLOUGH. Yes, sir.

Representative HOLIFIELD. And you do, do that?

Dr. McCULLOUGH. Yes, sir. There have been sofew instances that this is really theoretical.

Representative HOLIFIELD. I understand. I might apply this to your general work. Under those circumstances you function on a per diem basis and expenses?

Dr. McCULLOUGH. Yes, sir.

Representative HOLIFIELD. Has there been any intimation on the part of the Commission to deny you meetings when you thought they were necessary or trips to places where they may have been excursions or malfunctions?

Dr. McCULLOUGH. There have not been any cases of malfunctions or excursions since we have been in existence.

Representative HOLIFIELD. Let us refer then to the bimonthly meetings which you have and I believe you said, or when you thought they were necessary. Has there been any limitation by the Commission in exercising your judgment when you should have meetings?

Dr. McCULLOUGH. No, sir.

Representative HOLIFIELD. I think this committee would want you to exercise your judgment fully without restriction in this field. I think this is one of the most important fields that we have to exercise our responsibilities as Federal responsibilities.

Dr. MCCULLOUGH. Thank you sir. We intend to function that way.

Chairman DURHAM. We want you to be free and independent.

Dr. MCCULLOUGH. Yes, sir.

The Committee also maintains liaison with technical and professional groups working in the field of reactor hazards, such as the American Standards Association committee on reactor hazards; the special committee on nuclear power, ASME Boiler and Pressure Vessel Committee; and the standards committee of the American Nuclear Society.

Representative HOLIFIELD. Do you have an adequate staff?

Dr. MCCULLOUGH. We are in the process of getting adequate staff. Not as yet.

Representative HOLIFIELD. Your function is going to grow very rapidly in my opinion?

Dr. MCCULLOUGH. Yes, sir.

Representative HOLIFIELD. I am somewhat concerned about the fact that you are on an intermittent basis and that you are not a full-time committee. You say that the Committee consisting of members who can only devote limited time to its work cannot of itself make complete technical studies.

I do not know that complete technical studies are indicated, but certainly this indicates that you do have other positions and I hope when it comes to giving time to this that you will give such time as is necessary, and as the burden grows, if you cannot discharge it on a temporary basis I hope you will make it known to this Committee the increase in your burden and either assume it by full-time occupation or recommend that someone be appointed that can assume it.

Dr. MCCULLOUGH. We appreciate that, sir. What we are trying to do is this. There is a technical staff within the Commission that has been mentioned already, the Hazards Evaluation Branch. We hope to use their technical people to give us the necessary legwork and backup of our function. This is our intent. We do not wish to duplicate any manpower that can be avoided, sir.

Representative HOLIFIELD. I think this is proper. But you must have some staff. You must have a permanent staff with an office, to keep your records and keep you alerted to problems as they arise.

Dr. MCCULLOUGH. We will deal with that briefly here and I will enlarge on it if you wish, sir.

Subcommittees are appointed and meet when necessary to deal with specific subjects, reporting back to the full Committee before any formal advice is given to the Commission.

When it appears desirable the Committee will hold its meetings at locations other than Washington, including the specific site under consideration.

Up until now, because of time limitations, the Committee has confined its work to reviewing the certain specific reactor cases already referred to. In order to fulfill its more general duties on reactor safety standards, the Committee in cooperation with the staff of the Com-

mission is considering how best to set up criteria to be used in evaluating the hazards of all reactors.

For the Committee to perform its work, the Commission has provided office space, certain clerical assistance, and is in the process of providing an adequate administrative staff. We do need some full-time permanent people to watch out and channel things to members as required.

Chairman DURHAM. Is this the technical staff or a clerical staff that you are speaking?

Dr. MCCULLOUGH. It is a mixture of administrative and technical. As I said before, we are going to try to rely for most of the technical legwork on the staff which already exists, if we can.

Representative HOLIFIELD. For clarification, may I ask you a question on the last paragraph there. You speak of evaluating the hazards of all reactors. Does this scrutiny by yourself go as far as the disposal of the waste materials?

Dr. MCCULLOUGH. The Committee has never concerned itself specifically with the disposal of waste materials from chemical processing plants. We have concerned ourselves with the incidental waste itself from reactor operations. If you would like to enlarge on that, Dr. Abel Wolman is an expert on environmental problems and he would be happy to talk about it, I know.

Representative HOLIFIELD. We are going to have hearings on the subject of waste disposal, I believe, in April and we will give you a chance to go into this in some length because I think this is another area that I think we have to watch very closely.

Chairman DURHAM. You may proceed, Dr. McCullough.

Dr. MCCULLOUGH. In performing its role with respect to indivdual reactors, the object is to clearly define the real hazard, if any, involved in the construction or operation of the reactor and any limitations which the Committee considers proper to be imposed to keep the hazard at an acceptably low level.

The Committee avoids concerning itself with problems of national policy other than the question of safety. The Committee believes that it is possible to conduct the operation of nuclear reactors without unnecessarily exposing the public or workers to harmful amounts of radiation.

The Committee recognizes that adding safety precautions involves some additional expense. It is concerned about the heavy burden of cost which excessive safety protection may entail. The Committee is trying to find that level of protection which will result in adequate safeguards to the public without excessive cost. It believes that in this early stage of the technology safeguards may be imposed which, in the future, may be found to be unnecessary.

The Committee has not failed in our opinion and will not fail to point out a hazard for the sake of minimizing expense.

Representative VAN ZANDT. Doctor, in connection with expense, does your experience to date warrant you to make an estimate of how much of a dollar spent on a reactor represents safety?

Dr. MCCULLOUGH. Sir, I have thought about this and explored it. I do not have a definite number. There have been some discussions with technical people on this point. There is one paper that I recall particularly which indicates that it is a very large fraction.

Personally and speaking from my own view, I think this paper overemphasized the problem. If you talk about the containment problem alone, a rough estimate of the cost of containment—and this is just one item, sir—is of the order of 5 to 15 percent, depending on circumstances. Personally, again speaking as an individual, I do not think that this is an excessive burden at this stage of the art, although I personally would like to get rid of containers if we could do so.

It is a very difficult question to arrive at this figure because when you consider the number of controls that you put on a reactor, for example, it is hard to know which one are put on to protect the public and which ones are just good engineering. We have not arrived at an answer yet, sir.

Representatives VAN ZANDT. Thank you.

Chairman DURHAM. You may proceed, Doctor.

Dr. MCCULLOUGH. It is the committee's opinion that operation of a reactor without accident does not of itself give an adequate understanding of what the hazard may actually be. This understanding can only come from study and experiment pertinent to the safety problems.

This is why I said awhile ago in our statement that we encourage research by the Commission in the problems of reactor safety through these experiments because only by that kind of experiment can we get an appreciation of what the problem is.

The committee acknowledges that our safety record with nuclear reactors has been good. This record has been due to competence, foresight, care, and perhaps a certain amount of good fortune. The committee recognizes that this record and good fortune may not always continue.

To maintain the record and safeguard against accidents, the committee believes that there must be a constant and continuing realization on the part of the designer, constructor, operator, and owner that the highly toxic radioactive materials present in a reactor require special equipment and special operating procedures to avoid release.

The committee attaches great importance in reviewing reactor projects to the competency, special knowledge, and sense of responsibility on the part of the designer, constructor, operator, and owner.

The Advisory Committee on Reactor Safeguards realizes its responsibility and will direct its efforts to giving recommendations which are practical and at the same time, as far as its knowledge and ability permit, adequately protective of persons and property.

That completes the formal statement. May I return to your question about construction permits, sir?

Representative HOLIFIELD. Yes, sir.

Dr. MCCULLOUGH. On page 7 of the formal statement you will notice it says "involved in the construction or operation of the reactor." It has been the practice that when a case comes to the Commission in the construction permit stage it is referred to the committee for review.

The NACA reactor, sir, is in the construction permit stage, for example, and the committee did review this and made a report, which I think has been made public and hearings are in progress on it. Answering your question directly I feel it is very essential that the committee review projects before construction starts or before it gets

very far, because we must have some view of what kind if a reactor it is, and what kind of hazards it may impose.

Also, particularly at this stage of the art, sir, if there are problems that need solving before the reactor can operate I think it is only fair to the industry, public, and everyone, that these be pointed out in the construction stage.

Representative HOLIFIELD. I believe that the legislative history would sustain the point that the committee expected in the law that the public would be safeguarded. I think that safeguard should apply in the construction period or in the granting of a construction license as well as any other license.

I am going to ask you, how can you give a license for the construction of a reactor which has never been constructed before and be sure that you are granting a safe license. I will apply this specifically to the experiments which have been conducted on the fast breeder type of reactor, the EBR1 which melted down as the result of an incident. The EBR2 which will be quite a bit larger size reactor, but along the same general principles, and which will not be finished until 1960, upon which the PRDC reactor plans to have its engineering based when it comes to the reactor stage.

How can you in advance of certain experimental work on the EBR2, the completion of it and the operation of it for at least a reasonable length of time, justify clearing the PRDC for a full-scale reactor such as is contemplated?

I recognize that this is a controversial subject. It has been a matter of controversy between the committee and the Commission. I do not ask you this question to embarrass you in any way but I think it is something that comes within your responsibility and within the responsibility of the Commission and this committee.

It is this committee's responsibility now that I am thinking of.

Dr. MCCULLOUGH. Let me try to respond to your question. In the construction stage of a new type reactor—and frankly, in all cases of large reactors I feel they are for all practical purposes new types—it is impossible to give a construction permit which then can be guaranteed to be converted into an operating license in my view.

The dilemma is that persons wishing to construct a reactor would like to know, before they commit large sums of money to construct, that they can operate. This is a perfectly reasonable point of view. So we have a dilemma here that you can't resolve.

Representative HOLIFIELD. It can be solved?

Dr. MCCULLOUGH. We think it can be solved.

Representative HOLIFIELD. It can be solved except unless by prohibiting the large reactor until additional data is concerned is one way?

Dr. MCCULLOUGH. Yes.

Representative HOLIFIELD. Let us assume that the EBR2, which is to cost around $27 million, is completed and runs for a period of time and you deem that the principle of safety has been well demonstrated, then I admit that the full-scale reactor would be completely new, but it would be an extrapolation probably in size and certainly an extension of the principles which had already been proven to be safe, or at least some of them.

Would that cover all of the principles or not?

Dr. McCULLOUGH. Actually, the problem of a reactor of the fast breeder type presents a number of problems which are in the process of being solved.

You remember that the EBR1 had a core that was melted and it now has core 3, which was built to try to resolve some of the questionable characteristics. This is one experiment that is going on. Other experiments are going on in the Commission program which bear on certain other aspects of the problem. If these experiments are all successful, to answer your question properly, then you can make a reasonable extrapolation. You cannot tell at this stage of the game how successful the experiments will be. If you knew the answers, you would not have to make the experiments.

But, as you go along and make more experiments and gain more experience, you begin to have a feeling of confidence as to how far you can extrapolate.

Representative HOLIFIELD. This presents a real dilemma to the builder?

Dr. McCULLOUGH. Yes.

Representative HOLIFIELD. I do not bring it up from the standpoint of extending the argument, but from a real concern of how we are going to get on with the industry if we assume a position of waiting until everything is proven. You cannot get along with the industry that way, it is obvious. So there has to be a calculated risk. But I am hoping that in the consideration of this calculated risk which is taken that the Safety Advisory Committee will recommend, to the best of their ability, every safeguard possible to not just assume the risk without also saying that there may be a risk, and if there is a risk here, how can we direct the engineering so that a safeguard is built concurrently with the building of the risk.

Dr. McCULLOUGH. This is the way we have tried to solve this problem: To give a construction permit, pointing out the areas that require further work, and so in a sense it is a conditional permit.

May I say that the words "construction permit" may have misled us in some respects here. The construction permit, when you want to put an addition on your house, has the concept that you have a complete description of what you are going to do before you get the permit. The construction permit in this reactor business is not the same thing.

Representative HOLIFIELD. That is right.

Dr. McCULLOUGH. So what we have tried to do in the case of large reactors is to try to do it step by step and keep informed each step of the way. The old committee functioned this way and we hope the new committee will.

For example, in one of the large reactors, they have already had one big information meeting and they are scheduling another one very soon, at which they will tell where they are, how they are solving the different problems, and what they know that they must face before they complete the construction.

Representative HOLIFIELD. Is it possible in the case of a reactor such as the PRDC for them to build certain parts of the reactor—I am not thinking about the building or foundations or the roof, but the reactor itself—when there is still a large area which is still in the realm of the unknown?

Dr. McCULLOUGH. There are two ways of approaching this. They could hold up on certain of the controversial—I am speaking technically now and unknown features is a better word—and the other thing they could do, if, in their technical judgment, they feel it is worthwhile, is to construct the particular part, realizing they may have to redo it. It is their money and I guess they can make that choice.

Dr. WOLMAN. I would like to add another alternative, if I may, Mr. Chairman, and that is the alternative of deferring the construction at a particular location, which is part of the evaluation which the committee should make and does make of the series of alternate choices that you refer to.

There are a series of scientific and technological alternatives. There is the question of containment, and there is, lastly, the question of site.

Representative HOLIFIELD. I might say while I was in England recently, I talked to the gentleman who was in charge of the site location and also I talked to the man in the same position in Norway, and the chairman here talked to the man in Belgium.

In the Scandinavian countries, the site is the first thing that is considered, and unless the site is approved, all the rest of it goes by the board.

I wonder what your attitude is here. It is obvious that a dangerous type of reactor built somewhere out in the wilderness would not represent the hazard of one built in a city like Los Angeles.

Dr. WOLMAN. Our dilemma is another one. I think it is one which the committee and the public will have to recognize.

Increasingly our reactors, certainly for power and for heat purposes, would serve the greatest usefulness as close to the population as you can get.

Representative HOLIFIELD. This is true from the standpoint of economics. The same thing is true of powerplants. We are transporting kilowatts from the Hoover Dam to Los Angeles, which is several hundred miles, as you know, and we have a loss on the way.

Dr. WOLMAN. Yes.

Representative HOLIFIELD. This loss you would have if you located a reactor at some distances, say 75 or 100 miles—you would have more transmission loss—in getting the electricity into the center of us. We have absorbed that cost in this case that I mentioned.

Certainly it would seem that this is one of the cost factors that would have to be absorbed if safety of population is at stake. It is just an additional cost factor that has to be considered.

Dr. WOLMAN. I posed the problem not in order to indicate that the conclusion of the committee has been to bring them as close as possible, but I pose it because it is a problem for the committee.

Representative HOLIFIELD. In the Scandinavian countries, they are building these reactors underground, which gives you an added sense of care and precaution. This again may increase the cost of construction. I am not sure.

Where it is necessary to put it close to a populated area, it does add a note of safety which you do not have in an above-the-ground reactor.

Dr. WOLMAN. Our Committee is, I think, confronted with that equilibrium that you so well described.

I am not certain at all that all of us have resolved those value judgments in relation to distance and population. I am sure that Dr. McCullough would say to you for the Committee that there are very seri-

ous questions that arise with respect to newer ones and more numerous ones that will grow in our country, as to whether the site selection does not become the key answer as the art and science advance.

I, for one, place the site selection, perhaps because of past experience in my own professional function, as the No. 1 consideration. That has to be balanced against the desire of everyone in our country to move this art forward as rapidly as possible.

Chairman DURHAM. Doctor, that was the policy of the Federal Government in the beginning of this atomic-energy program. I was on the old committee that started out with it.

Representative HOLIFIELD. That is why we chose Hanford and Oak Ridge and those more or less isolated areas, and also Savannah.

Dr. WOLMAN. I would point out that the country is smaller as we move into increasing numbers and types than all of us thought it was. Of course, it is not as small as Norway or even Sweden or England.

Representative HOLIFIELD. Take the case of England; I visited the Dounreay station, which is at the northernmost end of England, a long ways from their big site and a long, hard trip up there and back.

Dr. WOLMAN. They are confronted, of course, with the increasing problem of distance for approximately the same reasons. I wish there were a mathematical formula by which we could equate distance and population and safety. Inasmuch as there is not, each of us on the committee is burdened with that conscientious task of writing that equilibrium.

Chairman DURHAM. This committee, more than any group of people in the country, realizes the problem you face.

Representative HOLIFIELD. And the responsibility which you carry is really the responsibility of whether this art shall go forward or not. If you fail to safeguard the people and we have one large reactor incident in this country close to a populated center, and several thousand and maybe a hundred thousand people are contaminated by one mistake, this will put the finish on atomic energy for a long time as far as further progress is concerned. The people just will not stand for it.

Dr. WOLMAN. That is right. But in order to derive some sympathy for the Committee, which is not our purpose today——

Representative HOLIFIELD. You have it already, and our respect as well.

Dr. WOLMAN. The Committee has been in the course of its last 10 years of operations in one form or another accused, if not publicly, but privately, of retarding the development of the industry for the very reasons which you have discussed. That adds to our second dilemma.

I could enumerate perhaps 10 or 15 additional ones.

Chairman DURHAM. Mr. Stratton, do you care to comment?

Dr. STRATTON. To discuss momentarily Mr. Holifield's question on the conditional construction permit, it is fortunate that in general these large plants take so long a time to be constructed that much of the safety requirements are met well within the projected area of time.

I would only reaffirm Dr. McCullough's statement about our concern of the consideration of hazards from a cost standpoint, we do

not consider cost at all insofar as safety is concerned. This Committee places no pricetag on safety.

Representative HOLIFIELD. This is a very heartening statement. I hope you will always feel that this committee is 100 percent behind you.

Chairman DURHAM. There is no question about that, particularly since we will have a display of the incident at Houston on television this week.

Representative HOSMER. As the problem presents itself to you today, how much is designing in safety features and how much is designing out features that are no longer found to be necessary?

Dr. MCCULLOUGH. At the present time, sir, I cannot recall any case of designing out. Mostly it is the other way. We are designing in.

Representative HOSMER. To meet all possible contingencies?

Dr. MCCULLOUGH. Yes, sir; to be sure that they have faced the technical problems.

Representative HOSMER. We will come to a point somewhere in technological development where we start designing out; will we not?

Dr. MCCULLOUGH. I hope so, and I think so.

We have repeatedly turned on the applicant and said, why did you put such a thing in there? We have had a variety of answers. Sometimes they said because they thought the safeguard committee would require it. Usually we do not like this. We tell them so. We say, listen, you do not put anything in that you as an engineer do not think is necessary.

By and large, I think the people have been conscientious about putting in the things that are really required and have not gilded the lily very much.

Representative HOSMER. How do you feel the attitude of the British is compared to us in relation to the safety question?

Dr. MCCULLOUGH. Sir, I have talked to the British. When you get down to the technical level, I think you will find that they are remarkably the same in their philosophy as we are. There are certain differences in some of their actual implementation of their philosophy, but basically, it is the same.

Representative HOSMER. They will take more chances; will they not?

Dr. MCCULLOUGH. I would rather not say that.

Chairman DURHAM. Having visited all of those installations this year, I believe you are correct, Doctor; they are following pretty carefully along the same lines as we are, as far as I could determine.

Dr. MCCULLOUGH. I have also had the pleasure of talking to some of the Swedish people and I am surprised how close they are to our philosophy.

Dr. STRATTON. We hope to get to the Geneva Conference and may come back by way of Sweden and Norway and England and bring back our impressions at that time.

Dr. MCCULLOUGH. I think that is one field where the exchange would be very valuable to all concerned. I cannot see why we cannot pool that to the uttermost in anyway we can.

Mr. RAMEY. On this comparison with the British, on this Windscale accident that they had, does not that indicate that possibly they are a little more informal in their safety practices and they have not

required operating manuals to the extent that the Reactor Safeguard Committee has required of the Commission on this kind of detailed consideration for safety.

Dr. McCULLOUGH. I think this is what happened: They had not given it as thorough and careful review and written the detailed instructions. I think they recognize this. The fact is, as I understand it, the first white paper indicated that they recognized their deficiencies and were doing something to correct them.

Representative HOLIFIELD. Mr. Chairman, at the proper place, probably in the appendix, I think this brief report on the Windscale incident should be included in our hearings because it is one of our most important examples of what actually occurred in the case of an accident. I notice it is called an accident, too, and not an incident.

Chairman DURHAM. Without objection, it will be so included.

(See appendix, pp. 616–620.)

Representative HOSMER. This incident with the boiling water reactor was a deliberate incident.

Dr. McCULLOUGH. Are you talking about the EBR1, sir?

Representative HOSMER. What is it?

Dr. McCULLOUGH. The Borax experiment.

Representative HOSMER. Yes.

Dr. McCULLOUGH. This was a deliberate insertion of reactivity. It was not an accident really.

Chairman DURHAM. Mr. Ramey.

Mr. RAMEY. On the question of site selection and location, does the Commission have a practice, or do you think it would be a desirable practice, when a safety question does arise on location, that alternative sites be considered which might serve the purpose better?

Dr. McCULLOUGH. If you are talking to the committee, I do not believe the committee has any firm policy on this question at the moment. There is a dilemma here.

If you let them submit comparative sites, you must be careful that you do not get in the position of selecting the site for them. If Dr. Wolman wants to speak to that, I should be glad to defer to him.

Dr. WOLMAN. I should like to comment on that.

The committee now functions on a given site submitted by the applicant. It has always been my judgment that that site may be fortuitous for one reason or another. It may be appropriate or inappropriate for the particular facility.

I frequently am of the feeling that alternative site indications should accompany the applicants report, as a site person and as a person interested in environmental conditions. I often find myself being pushed into a corner of accepting a facility on a location which may or may not be quite acceptable to me.

I think the Commission and the committee have taken what seems to be a well-warranted position that they do not want to select the site for the applicant. But somewhere beyond that philosophy I think we will have to move. Sites sometimes are selected for reasons other than total safety. They may still afford safety, but that may not be the dominating reason.

Dr. McCULLOUGH. May I add here, sir, that we have asked Dr. Wolman to head up a subcommittee to explore this very problem of the environmental conditions and how you tackle them and he is

pulling in consultants and trying to pull something together. We are aware of this problem, sir.

Mr. TOLL. I think one more point might be cleared up and that is this: At what points in the process is your committee required to make this report on power and testing reactors?

The last sentence of section 185 of the act says:

> For all other purposes of this Act, the construction permit is deemed to be a license.

Also, the joint committee report on Public Law 85–256 indicated, I believe, that your committee was required to make a report on certain types of reactors before the construction permit is issued as well as before the operating license is issued.

Is that your understanding, sir?

Dr. MCCULLOUGH. That is my understanding, sir.

The wording that Mr. Stratton is reminding us of is that on the application—and the application has to be made before a construction permit is granted—it is my understanding that we consider it before the construction permit is granted.

Mr. TOLL. You issue two reports normally?

Dr. MCCULLOUGH. Yes, sir. Maybe more interim reports. But certainly the construction permit and the operating license.

Chairman DURHAM. Thank you very much, doctor.

Dr. MCCULLOUGH. Thank you, sir, for inviting us.

Chairman DURHAM. The committee is adjourned until 2 o'clock this afternoon and we will meet in room 1334, New House Office Building.

(Thereupon, at 12:40 p. m., the committee recessed, to reconvene at 2 p. m., same day, in room 1334, New House Office Building.)

AFTERNOON SESSION

The hearing was resumed at 2 p. m., pursuant to the recess, in room 1334, New House Office Building.

Chairman DURHAM. The committee will come to order.

This is a continuation of the hearings on the progress and development in atomic energy. We completed the Commission's testimony this morning.

This afternoon we have with us Mr. Michaelis from Arthur D. Little, Inc.

We are glad to have you with us. Have you a prepared statement?

STATEMENT OF MICHAEL MICHAELIS, ARTHUR D. LITTLE, INC., CAMBRIDGE, MASS.

Mr. MICHAELIS. Yes, I believe you have a copy of it, sir.

Chairman DURHAM. You may proceed.

Mr. MICHAELIS. I should like to thank you, Mr. Chairman, for extending to me the invitation to present testimony before your committee.

Chairman DURHAM. We are glad to have you. I am sorry it had to be so cold.

Mr. MICHAELIS. Thank you, sir. Fortunately it is not as cold as where I came from.

Last year when I had the privilege of appearing before this committee, Mr. Chairman, I urged American industrial and commercial

enterprise to take the lead in making atoms for peace a reality through atoms for trade. I suggested then, as I do now, that America's high stakes in worldwide nuclear power development combine uniquely the commitments of foreign policy with the best short- and long-term interests of American business. As one method of fostering atomic trade to national and corporate advantage, I proposed that American and foreign companies establish jointly owned enterprises to develop and manufacture nuclear equipment, for sale where nuclear power is most needed—in Europe and Japan. In the past year, some 30 agreements have been made for joint ventures of various kinds between American, European, and Japanese companies. This is a welcome sign of the growing awareness that world markets are important to our nuclear industry.

Today, with your permission, Mr. Chairman, I should like to comment on the acceleration of our nuclear power program which is considered essential for our national posture in world affairs.

The burden of my argument is that the Government's price for fissionable material and associated processing operations is potentially one of the most significant factors that determine the course and speed of power reactor development. I recognize that major considerations in setting the prices for fissionable material have been:

1. To meet our defense needs for these materials through production in Government-owned plants;

2. To maintain profit incentives for industry to take over production with private financing at the earliest opportunity.

This policy has been remarkably successful on the first count: we seemingly are getting all the uranium we need—in all the forms and shapes desired—albeit at a price. This policy, though, has been only partially successful as regards the second objective: Large and essential segments of the nuclear fuel business are still in Government hands and are likely to remain so for some time, since it is in the nature of things that limited commercial markets do not provide adequate incentives. I suggest, therefore, that we make a temporary sacrifice in order to achieve a long-term gain.

Inasmuch as the real incentive for industry to finance privately all the required fuel operations will derive from the growth of a major nuclear-power complex in this country and abroad, I suggest that the Government's fuel price schedule be adjusted to accelerate the building of power reactors. This will require a reduction of net fuel costs for power reactors—or the time being. This will mean a temporary removal of any profit incentive for industry to enter the Government-held segments of the fuel business. This sacrifice—small in actual practice—will lead to a long-term gain in that the accelerated schedule o reactor building will provide the increased fuel demand for a realistic and privately financed entry of industry into fuel-cycle operations.

I believe that a suitable revision of Government-controlled fuel prices, together with assistance on research and development costs for power reactors will serve to accelerate our nuclear power program. It can do so to the extent needed to maintain world leadership and to provide our industry with the increased experience required to participate effectively in worldwide nuclear-power enterprises.

Furthermore, I submit that a fuel price schedule of the kind I envisage need neither affect detrimentally the technological direction of reactor development, nor create any imbalance between public or private ownership of powerplants. This form of Government assistance will in effect stimulate a matching of private with public money to accelerate both nuclear power developments and fuel services for the national good.

In public debate, questions are repeatedly raised on the progress of our program. Are we leading or are the Russians or the British ahead in the race? This question and others like it indicate our continuing preoccupation with the means to an end—with the program—rather than with the end itself—with our objective. It is fortunate, though, that those of us who have the responsibility to set policies have begun to reexamine our purposes. We must define our objective precisely. We must express its scope in practical rather than ideological terms. We must set a timetable for reaching our goal. Only then can we select the program best suited to meet our needs, and only then can we measure its rate of progress realistically. In short, we should be less concerned with competing with the Russians and more concerned with competing with our objective.

As I see it, our objective is twofold:

1. To develop nuclear power at a rate consistent with our domestic needs;

2. To assist other nations of the free world to develop nuclear power at a rate consistent with their economic and strategic needs.

It is evident that the end objective is the same—to develop economical nuclear power. But the timetable differs for the two aspects of our objective. Ours is a long-term need, while that of many other countries is immediate.

The question is: Can we establish a development program that will properly reflect these differing degrees of urgency, a program that will enable us to reach our objective without recourse to practices that may be injurious to our private enterprise economy? I am convinced that this can be done.

Looking back over the past few years of nuclear power development in this country, we see many achievements of which we can be justly proud. The effort made by industry and Government, in partnership, is yielding results which indicate that economical nuclear power will become available in this country in sufficient time for our economic needs. There may be differences of opinion regarding the wisdom of pushing one or another of the many reactor types now under development, but we are fortunate in that our economic circumstances allow us the luxury of extensive long-term experimentation to find the types of reactors most suited to our needs.

Many of our friends abroad, on the other hand, cannot afford this luxury, in terms of either time or money. However, their goal of economical nuclear power may be easier to reach than ours in most cases, since scarcity of fossil fuels makes their conventional power costs from 50 to 100 percent greater than ours. Nonetheless their immediate needs for nuclear power must be met at financial costs consistent with their national economies.

Nuclear research, as we know only too well, is a costly undertaking. It is remarkable that the United States, Britain, and France each now

allots almost exactly the same proportion of its national income, about three-tenths of 1 percent, to nuclear research for peaceful uses. However, the peaceful work done in each of these countries benefits to some extent from its military effort. It is probably more realistic to say, therefore, that an amount nearer to six-tenths of 1 percent of the national income is needed for serious and independent nuclear power development. If we compare this portion of the national income of different countries with the capital expenditures required for the foundations of a nuclear industry, we find that the only other countries able to sustain such an effort are Western Germany, India, Canada, Japan, and Italy.

The inadequacy of national funds is, of course, a prime motivation for regional compacts such as Euratom and the European Nuclear Energy Agency. Even such pooling of resources, however, is likely to be inadequate to meet Europe's nuclear power needs in a sufficiently short time. Recent estimates suggest that, in spite of concerted efforts, only about 40 percent of Euratom's goal of 15 million kilowatts of nuclear power by 1967 may in fact be achieved.

In comparison, the installation of a like amount, 6 million kilowatts, need not occur in the United States before the early 1970's.

These figures indicate, at one and the same time, Europe's urgent need of assistance and the differing timetables for our domestic and foreign objectives in nuclear power development.

As citizens, Mr. Chairman, we tend to think of ourselves in terms of world leadership and prestige, while as industrialists and businessmen we must remain hard headed in regard to profit and loss accounts. These two viws are not inconsistent, even in the case of nuclear power, which is certainly no money-making proposition, as yet. If we agree that our national efforts in nuclear power must be intensified and speeded up to fulfill our international obligations, to maintain our leadership, and to strengthen our prestige in this sputnik age, then we imply that this objective is for the national welfare. If an acceleration of our effort for this purpose calls for greater financial expenditures, the use of taxpayers' money appears justified, provided that it is spent to fulfill our international obligations to greatest advantage without unbalancing our national economy.

There seems little disagreement today with the suggestion that our nuclear development program be accelerated for foreign policy reasons and that public money be used for this purpose, since profit incentives for private enterprise are lacking for an accelerated program. I say this in full recognition of the fact that private money is already being spent at a rate adequate to sustain our purely domestic nuclear power development effort.

The $400 million question, therefore, is: How can the taxpayers' money be spent to attain an agreed national objective without disrupting the established pattern of our private enterprise economy? The point at issue, so hotly debated in these chambers during the last 2 years, is whether Government assistance should mean public ownership of the nuclear powerplants. I believe that few would answer this question categorically in the affirmative. However, our attempts over the past 2 years to find a compromise between public and private ownership issues on the one hand and an acceleration of nuclear power development to meet national objectives on the other, have been singularly unsuccessful.

Most of us will agree, I believe, that our claim to world leadership in nuclear power can ultimately be sustained only by practical assistance to other countries in building nuclear powerplants. Europe and Japan, in particular, need reactors today. I should like to see us go right ahead, in partnership with other countries, to help build these reactors. I am persuaded, however, to recognize also that, in order to be more adequately prepared to render assistance—and in so doing to enable our manufacturers to reap some deserved profit—it is essential for us to advance the art of nuclear power by building more full scale powerplants at home. That is more plants than would be required in the immediate years ahead for our domestic purposes alone.

Industry and Government together should therefore decide how many such plants must be built, of what type, and how soon. The setting of such a target must reflect the best judgment of utilities, both public and private, as well as of manufacturers and independent authorities in the nuclear field.

Public money, we have agreed, must flow into these additional plants in such a maner as to avoid preference to either public or private ownership. And here I come to the crux of my remarks.

There is another commodity which must flow without such preference; namely, uranium fuel. To a large extent, uranium fuel and public money are synonymous, since the major uranium production facilities are Government property. This is our clue on how to spend public money to build more reactors now without showing preference for public or private ownership of these plants:

A carefully conceived Government price schedule that reduces net fuel costs for reactor operators would stimulate immensely the immediate construction of nuclear powerplants, both privately and publicly owned.

Reference to table I illustrates my point. This table shows the three major cost components in nuclear power compared with the analogous costs for conventional power. These figures represent an estimate of cost reductions that are likely to be achieved at our present rate of progress.

(The table referred to is as follows:)

TABLE I.—*Components of nuclear-powered cost (150-megawatt plant, 80-percent load factor, 27-percent efficiency)*

	Mills per kilowatt-hour			
	1958–62	1963–67	Average conventional powerplant (1958)	
Capital equipment costs (15 percent annual charge)	9.6	6.8	3.2	
Operating and maintenance costs	2.0	1.0	.5	
Fuel costs (broken down below)	4.3	2.2	3.3	
	15.9	10.0	7.0	
Fuel costs (mills per kilowatt-hour):				
UF $_6$ (slightly enriched) from isotope-separation plant [1]			7.6	
UF $_6$ to UO $_2$			.9	
Fuel fabrication			1.9	
Shipping of spent fuel			.2	
Fuel reprocessing [1]			.6	
Losses			.2	
Use charge on inventory [1]			.7	
Total			12.1	12.1
Less:				
Plutonium credit, at $28.50 per gram (net) [1]			2.9	
Plutonium credit, at $10.50 per gram (net) [1]				1.1
UF $_6$ credit (net) [1]			4.9	4.9
Net fuel costs			4.3	6.1

[1] Controlled by Government pricing policy.

Representative VAN ZANDT. Is that 15.9 in the first column?

Mr. MICHAELIS. Yes; 15.9 mills per kilowatt-hour.

Representative VAN ZANDT. Then what year is the 10 mills?

Mr. MICHAELIS. Toward the end of the 5-year period 1963–67. I have for simplicity's sake used definitive figures to illustrate my argument. I believe them to represent a realistic average of the maximum-minimum ranges that should more prudently be quoted at this time.

The significant point to note is that although capital costs will be reduced by advances in engineering technology, and although operating and maintenance costs for nuclear plants can be expected to decrease, both of these cost components are likely to remain greater than those for conventional plants for some time to come. In order to make nuclear power economically attractive, and thus stimulate private financing of plants both here and abroad, the fuel costs must be reduced.

When we look at the typical breakdown of fuel costs shown in the table, we find that those items marked with a star are controlled by the Government's pricing policy. Since these are most of the large cost items, it is within the Government's power to adjust its pricing policy in such a manner as to reduce the net fuel costs to powerplant operators as needed to stimulate the building of these plants.

This I suggest is the manner in which public money should be spent—for the time being—to accelerate nuclear power development. Guaranties of the availability of nuclear fuels, at costs designed to stimulate nuclear powerplant construction consistent with our objectives, should be given to both publicly and privately owned utilities. Such guaranties should be in force for stated periods of time and should at least specify the maximum net fuel cost. The guaranteed fuel costs must also be set in such a manner as to avoid undue influence on the technological trend of reactor development.

With net fuel costs thus reduced, our estimates show that there would be an immediate incentive to build nuclear powerplants. Through the building of such plants, technology and engineering know-how will be advanced in such a manner that, within measurable time, utilities could well afford to pay, to an increasing extent, for the actual cost of nuclear fuel.

The pricing schedule for the whole nuclear fuel cycle should therefore be examined periodically to determine when an upward adjustment of the guaranteed net fuel costs would be justified. Such revisions would be made only at the expiration of the guaranty period then in force. The guaranteed net fuel price should at all times incorporate an adequate incentive for private industry, both manufacturers and utilities, to seek further improvements in fuel efficiency. Ultimately, net fuel costs will thus find their proper commercial level, at which time a sufficient volume of business will exist, insuring adequate profits, for a private fuel industry to take over from the Government.

I am suggesting, therefore, that existing Government control and—I should like to emphasize—existing appropriations of public money in the nuclear fuel business be used during this transitory phase in nuclear power development, to stimulate a matching of funds by private industry, which would then have a chance of building reactors without incurring crippling losses.

The precise manner in which such a Government-pricing policy for special nuclear materials and byproduct materials is established must be the subject of careful analysis. We should above all recognize the power that any nuclear fuel pricing policy can potentially exert on the technological course of reactor development. For example, the question of increased plutonium credits has already been debated. Although today the Government can probably afford to pay a price for plutonium that reflects its higher weapons value rather than its fuel value, the application of such an elevated credit to different types of power reactors could possibly lead to reactor design and operation that would unduly emphasize plutonium production over electricity production, if this is found to be financially profitable by the operator.

I would not presume here today to suggest the detailed manner of setting up a price schedule for the nuclear-fuel cycle optimized to accelerate power-reactor construction. But I do want to urge strongly that industry and Government explore the possibilities of applying a carefully evaluated scale of prices, designed to reduce fuel costs, in such a manner as to accelerate nuclear-power development to a rate consistent with our national objectives.

Since fuel inventory in any reactor is independent of plant use, it would be proper to consider it as a fixed rather than an operating expense in a manner analogous to conventional powerplant bookkeep-

ing, where central coal inventory expenses, I understand, are charged against fixed costs. (I have not shown it in this manner in table I, so as not to confuse that picture.) Particularly when seen in this light, it is evident that the fuel policy we are discussing would not favor either public or private ownership of powerplants, since it would enable both equally to use available capital to finance the proportionately high costs of capital nuclear equipment. Regardless of bookkeeping methods, however, this argument holds true. This form of financing nuclear power acceleration is therefore not likely to unbalance established patterns of our economy.

If I may interpolate in my prepared testimony, Mr. Chairman, I should emphasize that I refer here particularly to the public versus private power issue. I do recognize that other interests, such as the coal industry, might take exception to my claim that this approach will not unbalance our established economy. However, I do believe that any inroads that an accelerated nuclear power program might make on the coal industry are going to be extremely small. Against this small loss we should set the achievement of economical nuclear power as a national objective of great importance.

Moreover, I do not believe that a giveaway charge can be leveled against this approach, since public money will be used to enable nuclear fuel to be devoted to an advancement of the public good and to encourage the matching of public funds by equal or greater private funds.

After I had prepared my stestimony, Mr. Chairman, I had news of an industry opinion poll just completed by the Atomic Industrial Forum. The question was put:

Assuming increased Government assistance to reactor manufacturers and operators, which assistance route should be extended?

I was interested to find that 14 percent of the respondents favored adjusting fuel prices, and that a further 12 percent were for a revision of fuel reprocessing charges. A total of 26 percent, in other words, voted for adjustment of net fuel costs, while another 26 percent were in favor of preconstruction research and development assistance. All other suggested forms of Government assistance received fewer votes.

I personally believe that both forms of assistance, fuel as well as research and development, may well be required. Research and development assistance has already been considered in previous hearings, and I shall not discuss that particular subject further at this time.

The purpose of my remarks today is to recommend serious consideration of a new interim fuel price policy as a means of achieving our national objectives for nuclear power development.

Thank you, Mr. Chairman, for the privilege of appearing before this committee.

Chairman DURHAM. Thank you very much, Mr. Michaelis. You have presented us a thought-provoking statement.

I recall when you appeared before us last year, you made a suggestion which has been carried out to a certain extent in the foreign field among participating American manufacturers.

You state that there has been progress made in this field.

Now, your idea of changing the policy on the fuel pricing is entirely different from the policy in effect today. We have tried to put

a price on this or have put a price on it which would be an incentive to people to produce plutonium at a profit.

Is that the way you size it up?

Mr. MICHAELIS. Yes. I believe the policy that a plutonium credit of $30 per gram (which would represent a net credit of $28.50 per gram after processing charges) be extended to utilities is certainly an incentive for them.

I do believe, however, that singling out this one part of the whole nuclear fuel cycle for subsidy purposes could lead to the danger of affecting reactor development in the technological sense.

It would be conceivable, for instance, to think of reactor fuel elements being used in such a manner as to optimize plutonium production rather than electricity production if this is shown to be economically advantageous.

Chairman DURHAM. I can see your point there.

If the price went to a certain level so that you could make a better profit out of producing plutonium rather than electricity, you would be in the plutonium production rather than the power.

Mr. MICHAELIS. Yes. I suggest instead, therefore, that we examine the price schedule of the whole nuclear fuel cycle into which enter all sorts of factors as shown on table 1, such as reprocessing charges, use charges, and the actual price of natural and enriched uranium.

Chairman DURHAM. Did you take into consideration the price of fuel as of today or did you base it on some other figure?

Mr. MICHAELIS. The figures shown on table 1 are based on current fuel prices. They apply, specifically, to one of the largest pressurized water reactors now being built. They are representative of what I believe the utility building this reactor will be operating at when this reactor is completed.

Chairman DURHAM. Based on the present day prices of fuel?

Mr. MICHAELIS. Yes, sir. My purpose here today is to point out that those fuel cost items over which the Government has full control do in fact represent the large cost items. If you could reduce this 4.3 mills kilowatt-hour fuel cost component—let us say for argument's sake, to 1 mill or even half a mill, for the time being—you would give the utility a chance of generating electricity at 11 to 12 instead of 16 mills. At that price, I believe you would find that a considerable number of utilities, both public and private, could see their way toward starting on the construction of reactors right now. With the expectation of increased technology gains through this construction, they would find themselves in a position a few years hence to pay for the actual value of the fuel.

The Government price would then be raised and ultimately industry would take over when demand for fuel services justify it.

Chairman DURHAM. If we were to cut the price of fuel today to $15 instead of $30 a gram, have you any table as to the probable cost of power?

Mr. MICHAELIS. Yes. I show this plutonium credit, that I believe you are referring to, not quite at the $15 level but at the $12 level which has been suggested as the possibly realistic fuel value. You will note in table 1, that the gross power costs of this reactor total 12.1 mills. Against that I have set the credits that the Government is paying, which is for plutonium and unused uranium. The figure of 2.9 mills

of plutonium credit corresponds to the price of $30 per gram. The figure of 1.1 mills for plutonium credit corresponds to the price of $12 per gram which many people believe to be a realistic fuel value.

Therefore, the net fuel costs under the lower plutonium price would be 6.1 mills, as against 4.3 mills, and would, in effect, add another 2 mills, thus bringing power costs nearer to 18 mills instead of 15.9 mills.

Coming back to your earlier point, Mr. Chairman, this higher plutonium credit is an incentive. It is an incentive of roughly 2 mills at the moment.

Chairman DURHAM. That is, to the manufacturer?

Mr. MACHAELIS. No, sir; to the utility owning and operating the plant.

My point is that the Government has it within its power to go all the way and reduce the fuel cost temporarily to as low a figure as would seem justified to stimulate reactor construction.

Chairman DURHAM. In other words, your suggestion is to subsidize them by the low cost of fuel instead of research and development funds and other methods of financing?

Mr. MICHAELIS. I would not say instead of; I would say it would possibly be in addition to research and development funds.

Chairman DURHAM. I believe you said——

Mr. MICHAELIS. I did say "in addition," in my testimony, sir. I do not think research and development funds may be enough. This fuel assistance, I believe, may turn the edge. The important point I am trying to make is that this form of assistance would not give preference to either public or private ownership of plants. Both groups would have an equal chance of profiting from this form of assistance, by using the capital available to them to build the actual plant itself and not have to foot the fuel expense in addition for a while.

Chairman DURHAM. Your theory there, of course, would be the fact that you might have a high-priced production of power in some areas and low cost in others?

Mr. MICHAELIS. Yes, sir.

Chairman DURHAM. It would be the same to each one whether it is a high-priced area or a low-priced area. It would be up to the utility to be efficient.

Mr. MICHAELIS. That is right. It would stimulate the building of plants in the high-cost power area first. But that would be the normal trend. You are not changing that.

Chairman DURHAM. Mr. Hosmer?

Representative HOSMER. I would like to ask 1 or 2 questions about table No. 1. Assuming your fuel cost figure per kilowatt-hour is accurate, how accurate would you say are your capital equipment and operating and maintenance cost figures?

Mr. MICHAELIS. The capital cost figures are based on one of the most advanced designs of this particular reactor now under construction. These figures are based on prices obtained by utilities from the prime reactor contractor.

Representative HOSMER. Which reactor is that?

Mr. MICHAELIS. This is typical of the Yankee atomic reactor. That is a pressurized water reactor.

Representative HOSMER. That assumes that Yankee runs into no trouble and everything runs smoothly.

Mr. MICHAELIS. This assumes that the price is at the latest figure, which is said to be $60 million or so for capital costs in the case of Yankee. It has gone up from earlier estimates. The expectation is that it won't rise much more.

Representative HOSMER. Your operating and maintenance costs are estimates?

Mr. MICHAELIS. Those are estimates made by utilities looking at the complexity of a nuclear plant of this kind. It may cost as much as four times the operating and maintenance costs of a conventional plant right now.

Representative HOSMER. If these items other than fuel costs go up very much, a reduction in fuel cost is not going to accomplish the purpose that you have set forth in your testimony.

Mr. MICHAELIS. That is right. If the capital costs should go up another 50 percent, reduction in fuel costs alone will not be as much of an incentive, At the expected level of capital costs, though it could just make the difference.

Representative HOSMER. Combined with the research and development cost, which is the second thing you suggested, do you feel that additional factor would be sufficient to overcome the difficulties?

Mr. MICHAELIS. I think it would serve to stimulate the building of plants in this sense: A utility considering a nuclear powerplant today is looking at its investment on a 20-year basis; that is, over the full life of a plant. Yankee today—and, I want to emphasize I am not speaking for them—with the fuel price figured in at 4.3 mills roughly, feels confident, I believe, that over the long life of the plant it will probably break even, because improvements made in fuel performance, say 5 years from now, will enable it to make power cheaper, with the expectation that overall power costs from this plant might go below conventional power costs over a 20-year life of this plant.

An early reduction of net fuel costs, therefore, would turn the edge, I think, for many more utilities to take this risk.

Representative HOSMER. I presume there are people who are less optimistic than you, though.

Mr. MICHAELIS. I am sure there must be.

Representative HOSMER. For the record, would you state your connection with the Arthur D. Little company and what business it is engaged in?

Mr. MICHAELIS. Arthur D. Little, Inc., is a research and consulting organization with headquarters in Cambridge, Mass.; I am the senior atomic-energy consultant with them.

Representative HOSMER. Thank you.

Chairman DURHAM. Mr. Dempsey?

Representative DEMPSEY. No, thank you, Mr. Chairman.

Chairman DURHAM. Mr. Ramey?

Mr. RAMEY. Would you suggest some kind of assistance of this nature for foreign development at all by American manufacturers?

Mr. MICHAELIS. You mean a guaranteed fuel price for foreign utilities, essentially?

Mr. RAMEY. Yes.

Mr. MICHAELIS. I thought about this and I frankly foresee that we might be running into difficulties there because I would anticipate that our British and Canadian friends might be very perturbed if the

United States were to dump, if you will, nuclear fuel at a very much reduced price on what is after all their market, too.

My thought in this whole presentation is, let us agree that we must accelerate the building of plants at home to gain in technology and thereby put our industry in a better position to serve international markets. The question of how we might assist foreign countries or foreign utilities directly runs into a great number of international political problems which the State Department and others have spoken on from time to time.

I have not gone as far as saying that we should give the same kind of fuel assistance to foreign countries. I think this would need much more detailed investigation of all the international factors involved.

Mr. RAMEY. Would the same observation apply that you have on page 6 of your statement on the effect of the $30 plutonium buy-back price? Would that apply on foreign sales of American reactors, of encouraging reactors that would optimize plutonium rather than power?

Mr. MICHAELIS. I think it might but probably to a lesser extent. Since the goal in Europe is for say 10 mills per kilowatt-hour of electricity, as against our 7 mills, this goal is not as difficult to achieve and the plutonium credit is more in the nature of jam on the bread rather than butter—economically speaking.

I think it might apply to some extent but not as strongly as in our economy where we are shooting for a lower competitive electricity cost.

Mr. RAMEY. I have one last question. One question or objection that has been raised to subsidize through fuel element prices or through operation costs is that it is difficult to stop them once they get going. Whereas, if you provided your financial assistance by means of research and development help, or if you made a capital subsidy, it would be a one-shot affair.

Mr. MICHAELIS. That is right.

Mr. RAMEY. How would you keep this from being perpetuated?

Mr. MICHAELIS. I believe that this approach through full assistance would lead to an increased reactor building program. This in turn would lead to faster technological advances in the reactor art, in the art of extracting energy from nuclear fuel. I believe, therefore, that the price that utilities can afford to pay and still not incur crippling losses would rise as time goes along. It would rise much faster than it does now. Therefore, the guaranteed fuel price should be reviewed, as I have said, periodically, perhaps every 3 or 4 years to tie in with a building program which must be established first of all as a national objective. It should be reviewed to see if an upward revision is justified.

In the longer term, in 10 or 15 years, it would thus find its normal commercial cost level and there would be a sufficient amount of fuel business, because of the number of reactors built, for a private fuel industry to step in and take over some of the work that the Government is now doing and to set its own commercial prices.

Chairman DURHAM. Thank you, Mr. Michaelis. You have focused our attention directly on the point that has worried not only us but many people throughout the country. We want to do a job and not get involved in this public-private fuss and still retain private enterprise.

Thank you very much.

Mr. MICHAELIS. Thank you, sir.

Chairman DURHAM. Our next witness is Prof. V. L. Parsegian, chairman of the engineering group, Rensselaer Polytechnic Institute.

STATEMENT OF V. L. PARSEGIAN, DEAN, SCHOOL OF ENGINEERING, RENSSELAER POLYTECHNIC INSTITUTE

Mr. PARSEGIAN. Thank you.

Chairman DURHAM. We are glad to have you with us this afternoon.

Mr. PARSEGIAN. It is a privilege to be here and thank you for your invitation.

Chairman DURHAM. You may proceed with your statement.

Mr. PARSEGIAN. I would like to discuss the role of science in engineering schools, and in particular how to enable these schools to support the Nation's key technical projects more effectively.

It is necessary to go into this because it seems clear that the main stream of educational and research effort at universities is separated and out of tune with the major technical effort on which our national progress depends.

For introduction, I would like to follow about 100 young men who select science and engineering careers. Many of these hand-picked students will enter college with deficiencies which, incidentally, are not limited to mathematics and physics. We have much to learn about what and how to teach in science and engineering, and fewer than half of these 100 will be graduated. A half dozen to 10 may continue study to the master's degree.

Very few, possibly only 1 or 2, of the original 100 will have interest and ability for advanced study at the doctoral level. Such men are relatively few, but they are the ones on whom we must depend for major basic contributions.

There would be no difficulty in finding good schools if these men have conventional interests. However, it would be unfortunate if they should become enthusiastic for the fields that are supposed to be of key importance to the future of the United States, such as atomic energy, controlled thermonuclear fusion, rocket technology, or satellites.

In the case of these new areas, they would have trouble finding colleges with faculties sufficiently informed to guide their advanced studies. The reason is that the vast system of secrecy surrounding these fields, and their own aversion to classified research, have kept colleges out for some years. There would also be some difficulty in finding suitable thesis research which was not classified. As a consequence, the young men avoid these areas altogether rather than fight the nontechnical handicaps.

In other words, the present "security" system is ill-designed, and discourages our most promising scientists and engineers from going into these new areas when preparing for advanced specialization. We cry "shortage of scientists" for these new fields while stifling the only supply for such men.

For example, the new electromagnetics and plasma and particle physics that go with thermonuclear fusion are exciting to many college physicists, but they might just as well avoid thinking about this secret work.

Dr. W. Kenneth Davis of the AEC has said about problems of nuclear fuels and materials:

> Only the barest understanding of metals and some of the materials is beginning to evolve * * *. If ever there was a field in which more fundamental research was needed, this is it.

This was stated in his talk of June 3, 1957, to the Eighth Annual Conference on Industrial Research.

Colleges certainly have interest in this fundamental research. Nuclear metallurgy is among the RPI advanced nuclear courses being given both at the campus and at the Knolls Atomic Power Laboratory. But it is difficult to find theses which are informed on current materials research, of doctoral caliber, and yet sufficiently unimportant as to be unclassified. The young doctoral students would be out of luck here, also, although they are the very men needed for the research which Dr. Davis says is so necessary. Clearly, the colleges are prevented from performing their function of preparing young scientists for these important fields.

Turning to another aspect, Dr. Davis says again:

> There is a great lack of real basic research work and of support for such work. * * *
>
> Much that is called basic research today is not truly such, and we face a paucity of those new discoveries upon which our overall technical advance in past decades has been based.

It may be that this accounts for the low rate with which innovations appear in our nuclear-power program.

In contrast, the major lesson of the sputniks points not to the actual placing in orbit of the satellites, but to the quality and growth rate of Soviet educational processes, and especially the extensive basic and applied research which made these engineering feats possible.

Basic research is not easy to define. There are major examples in the discovery of X-rays, of radioactivity, nuclear fission, et cetera. It includes extensive mathematical and instrumental developments, and painstaking systematic study on the part of many people.

Such research has flourished best at universities where the motivation is knowledge for its own sake. It is almost meaningless to talk basic research to a man who has a project to complete, or to directors of laboratories who must show new products for their research spending.

How prepared are the universities to satisfy the basic research needs of the Nation?

The question has in mind the criticism that the United States has not been productive of basic research; that advances in technology have depended largely upon contributions from the universities of Europe.

Unfortunately, the criticism by Dr. Davis can apply also to many of our universities; they also are engaged too much on applied research, for several reasons.

First, even the colleges have not generally achieved tradition and zeal for knowledge for its own sake. We do not often enough educate men for basic exploration. There is a premium for learning facts, but not for questioning them. As a result, many scientists would have difficulty in undertaking basic research.

Secondly, there is too little money to encourage exploratory thinking or for research that has no immediate application. Many Government agencies will sponsor only applied research.

Third, basic research does not spring out of thin air; it often has its best source in challenging questions as to "why" and "how" of phenomena connected with major technological developments. All of the existing new fields mentioned above, atomic energy, reactor-fuel elements, thermonuclear research, new rocket fuels, satellite technology, could indeed become springboards for many basic research programs in colleges, if only they were not squelched by the bondage of secrecy.

For example, I remember that some years ago uranium tetrafluoride—or green salt—could be produced by two different processes. The salts from the two processes seemed to be identical, but they did not react the same way when used to produce uranium metal.

The production people simply eliminated the one process without feeling responsibility for pursuing why the two reacted differently. I do not know the current status of that question, but at the time it appeared that a college research study of this unique process might for the first time have given understanding of the basic molecular mechanism of metal reduction, about which we know very little. Unfortunately, this example is typical rather than an exception.

Such restricted interest in basic mechanisms is the very cause of the condition which Dr. Davis deplores. The Atomic Energy Act of 1954 encourages basic studies, but Congress might consider providing further stimulus to correct the situation.

For example, would it not be appropriate for Congress to include in each major production and development budget specific assignment of responsibility to initiate and support such studies as might be pertinent to understanding of basic processes?

One may ask, Should not basic research funds be administered only by research divisions? I believe such restriction is undesirable, because it completely disassociates basic interest from major activities such as reactor development. While we should support any basic or exploratory program that appears attractive, a very large number of top-quality research must find origin in questions connected with development programs. This would be so, both because we need basic understanding of our present operations and, also, because many science and engineering faculty members would have difficulty in conceiving more attractive programs.

There is one important requirement in all of this; namely, that the college investigator be permitted complete freedom in the conduct of the investigation, within limits of his total budget. That is, his primary goal must be basic understanding, not solution of engineering problems except as incidental advantage.

The last aspect I would like to discuss has to do with financing and contractual procedures, which become particularly troublesome when the intangibles of research are added to the problems of financing buildings, equipment, and conventional operations.

Colleges have been caught in quite a squeeze between the deflated dollar, higher costs, lower income from endowments, and loss of staff to higher paying industry. Philanthropists with large gifts do not seem to abound. Tuition, while high, still pays only about two-thirds

of the actual cost per student. Each year demands greater effort to solicit gifts to keep the institutions alive.

Science and engineering schools have the major problem of providing adequate laboratories and equipment. Research has become very expensive. Meanwhile, schools ought to provide research environment and opportunities to help thousands of graduate students to become better prepared for the new science and engineering of this decade. These graduate students must lead our technology, and strengthening their opportunities is much more important to the Nation than training more undergraduates would be.

As a result of shortage of funds, and of our "security" practices, these young scientists and engineers are denied contact with the basic research problems which Dr. Davis states are so important to the reactor development program.

It would seem that if each Government division were specifically authorized by Congress to support basic research at universities to the extent of 10 percent of its development budget, we would rapidly improve both the manpower and the basic research picture. Our graduate students could be given vastly improved preparation for the newest technology. Each main division could be sure that its long-range research interests were not forgotten.

Incidentally, I would expect this procedure to vastly increase the value of university research, which is now supported by many agencies. In my opinion, current research programs too often lack awareness of the main developments to be as good as they can be made.

There are other problems. All Government agencies have avoided paying full cost for work done at colleges. Overhead allowances, which range from 100 to 250 percent to profitmaking industry, are arbitrarily squeezed down to values well below actual costs in the case of colleges, ranging from 15 percent to about 90 percent. Allowances for buildings are avoided if possible. Benefits to teaching of students must be avoided. The school must show substantial participation in sharing expenses, in the form of buildings or equipment or salaries, or all three.

There may have been justification for some of this in pre-Sputnik days, but we can no longer limit the Nation's research potential to the financial limitations of colleges. Nor can we prejudice the advanced training of graduates, or the choice of programs which need attention, by dependence only on colleges that can find participation money.

Administering funds for university research has been a new experience for Government agencies, and they have not done too well. Research objectives, procedures, progress, are likely to be hazy and unclear in comparison to manufacturing operations, and nonscientist agents have had great difficulty with them. This has often led to distrust, restrictions, and irritating controls. Colleges resent deeply the maze of redtape that clouds nearly every aspect of dealings with the Government.

Meanwhile the majority of public servants also feel caught in a hopeless tangle that they can do nothing about.

After 7 years of intimate involvement, over half of which I was with the Atomic Energy Commission, it is my opinion that Congress should consider taking the initiative to help correct the situation.

I suggest this in part because it appears that the large Government agencies are too enmeshed in complex operations to be able to find a solution. Also, solutions are likely to require simplifying legislation, and revision of budget authority, which are informed on the details of the problem.

It is particularly important that final solutions be based upon confidence in the executive agencies and in the contractors, otherwise unnecessary legislative restrictions have a way of snowballing into an avalanche of controls and redtape by the time they reach the contracting officials.

I suggest that Congress consider initiating a study, with the support of the executive agencies, educators, and representatives of industry, of all aspects of the problem. The study might explore the questions of total national basic research financing, college research financing, long-term financing, and might develop guides for initiating, contracting, auditing, administering, and terminating of research projects.

The study might also consider how the leading scientists of the Nation can aid the Government in planning long-range and basic research in more effective cooperation than has been achieved thus far. In summary:

1. Every effort should be made to enable universities, their faculties, and graduate students, to participate intimately in the wide range of basic research activities that contribute to the development of atomic energy, controlled thermonuclear fusion, rocket, and satellite programs. This is necessary both because the projects need this support and because graduate students must be better prepared to contribute to the newest technologies.

2. This requires that the vast systems of information controls be eliminated as a way of life, that secrecy be limited to weapons design and test, that basic research results be once more "bornfree."

3. Much more money is needed to support basic research at universities. As an important step, it is recommended that Congress consider specific assignments of 10 percent of the development budget of each Government agency for the purpose of supporting basic research at universities, pertinent to the processes and long-range interests of each division.

4. An uncomfortable situation exists with reference to Government redtape and contracting procedures. It is urged that Congress consider initiating a study to develop clearer overall objectives, as well as simpler contracting procedures, for university research.

Chairman DURHAM. Thank you very much, Doctor. You have given us an excellent statement and one which I think I pretty well agree with.

In the beginning you make a statement about 100 men going to college and finally winding up with a half dozen with a master's degree and probably 1 with a doctor's degree.

Do you base that on any firm figures or is that just a figure pulled out of the air?

Mr. PARSEGIAN. The ratio differs greatly depending on whether one is talking about science students or engineering students. In the case of engineering students very few continue to the doctoral program.

In the case of science students, more do.

So you might refer to this as being something pulled out of the figures that are available without saying what the composition of the 100 students might be.

Chairman DURHAM. I know it must be quite a large percentage because I have seen the same thing happening in my own hometown where I have lived for 50 years or more, where you have very few boys at the doctor's degree level. You did not elaborate on the causes for this and whether or not it was a lack of training, beginning in the primary education field, whether it is the teachers of the colleges, or whether it is a lack of student interest. Do not all those things enter into this?

Mr. PARSEGIAN. They all enter into it. The students who come to colleges are not very well prepared. While the mathematics and physics aspect of their training certainly need attention, other aspects also do, and particularly improving of the opportunity for the gifted student to achieve his maximum capacity. When he comes to college, I might say, we are not too well prepared to do the best by him in colleges either.

Chairman DURHAM. I am a firm believer in basic research. I think it is fundamental if we ever expect to extend our economy and live, in an ever-growing population, in this country and in the world. These frontiers are very costly and time consuming and require talent. To get that talent you seem to think at the present time that secrecy has had a great effect in the development of people who are qualified to carry out basic research. I think that is an important matter. If that is a real cause the country ought to thing of it seriously. I think that is part of it. I do not blame it all on that. I am very much like you are, I do not like to be pushed around by Government redtape.

Having worked in the atomic-energy field for a good many years, you have the experience and speak from knowledge. How to get at that with the amount of money we are spending today on research in this country, which is a tremendous sum of money, is the problem. There are probably $2 billion or more in all fields of Government. We are putting out scholarships. I forget how many the National Science Foundation has put out this year in trying to encourage these students. Also, private industry throughout the country is doing a lot.

You seem to think it could be better coordinated in one basket, if I get your point.

Mr. PARSEGIAN. I think that is it, sir. From the secondary schools we fail to challenge the gifted student. It would not take more money to challenge the gifted student and get him excited about his own future and his own development. It would take some teaching that is designed to excite his interest.

In the colleges we fail in the same way. We do not challenge the student. We, for example, can not challenge him with the most exciting technical developments of this decade; namely, atomic energy and these other things that I mentioned. They are taught these as courses, that is true, and we have no end of material we can throw at them; but men, at this advanced graduate study level, are not excited about what has been. They are more excited and should become more excited about what is going on now and how they can pitch into it.

Chairman DURHAM. We have just concluded hearings with 30 or more of the top scientists in this country, teachers, laboratory men, and people who are qualified to speak, and I believe it was the general agreement among them, in arriving at some increase in this which everybody is demanding, that we could not possibly spend over 50 percent more money than we are spending at the present time and get good results.

Mr. PARSEGIAN. I do not think, sir, it is only a question of how much money we spend.

Chairman DURHAM. I agree with you on that. It is the application of it.

Mr. PARSEGIAN. We need much more money spent. However, spending much more money would not reflect directly on the activities in which the Atomic Energy Commission is deeply engaged. For example, in the development of better production processes and the reactor development program itself, unless in the course of spending of this money there was challenge to the students on the particular problems that are the key problems of this decade, one can spend no end of money on research, but we cannot afford all that.

Chairman DURHAM. I think I see your point in this matter.

Of course, under present-day conditions there is probably no college in this country that could build a cyclotron out of its own funds which is absolutely necessary today if the student wants to carry on basic research in the particle field. The Government has to participate in that and if it classifies something, it keeps it away from the students and very few get the benefit of it. It is the taxpayers' money, after all, that is being spent.

Mr. PARSEGIAN. Yes.

Chairman DURHAM. It seems to me that the educators and those who are in charge of these programs could be very helpful to the Congress. We have been very liberal here in contributing to research and development.

I think everybody is deeply appreciative of what we have done in the last 50 years. We have made quite a bit of progress.

Mr. PARSEGIAN. Yes, sir.

Chairman DURHAM. I do not want us to be stymied because of the lack of brains to put together with the money we have appropriated to produce results.

We people here are not scientists. We have to depend on the people who have the scientic brain. I could never have passed a physics course if I had not had a good teacher. If a man is going to get into this field of high competition in a couple of years, the student has to have a very good technical education.

Mr. PARSEGIAN. Yes, sir. At Rensselaer, it turns out that nuclear activities constitute a major activity. We have a cooperative program with the Knolls Atomic Power Laboratory. We provide the advanced nuclear courses to the staff of that laboratory.

The things I have said I have said with this intimate involvement in a teaching program which, however, falls short because it is not a probing research program. The need is for some money. The need is also to eliminate the handicaps that stand in the way of our doing more and other colleges also doing more.

Chairman DURHAM. I do not have any knowledge as to how many thousands of contracts there are in the universities. I am trying to get that information now from all the Government agencies downtown. All of the universities, knowing they are going to be classified when they go into these basic research fields, still seem to want these contracts.

I have always felt that this was the way to do this thing and not let the Government do all the basic research and get into the field of education and everything else in this country.

I think the universities can do it so much better if the program is properly run.

Mr. PARSEGIAN. Yes.

Chairman DURHAM. Mr. Price?

Congressman PRICE. Doctor, in the final paragraph of your statement, where you summarize, you state: "An uncomfortable situation exists with reference to Government redtape and contracting procedures." Have you had personal experience in this field that causes you to make that statement?

Mr. PARSEGIAN. Yes, sir. I was responsible, as authorized representative for a good many of the contracts that the Atomic Energy Commission supported in the northeastern universities, so that both from the experience with the Atomic Energy Commission and more recently experience in the college, I am led to say this.

Representative PRICE. This would be based, then, on the delay in the assignment of research work as a result of the redtape they must go through before they consummate a contract, or what is the basis of your complaint here?

Mr. PARSEGIAN. I think the complaints might begin, first, with the nature of the program that is proposed by an investigator in a college. We used to have a good deal of trouble in making the proposals that were sent in to be informed proposals, informed in the sense that if they wanted to work on a particular subject they learn what else was going on in that area before proposing something new.

They would not, for example, want to propose something that was already done.

We used to try to give them such help as we could. The principal investigators were usually cleared for access to classified information. But by and large, these gentlemen would not refer to classified information if they could avoid it. In some of the principal universities, the faculties have voted that they will not get involved in classified research.

Once we got past the definition of what they wanted to do, from then on it was a question of how to get the funds. Could the school afford to undertake this work? Much of the difficulty came with trying to squeeze down on the overhead that was allowed and the contribution that the schools would be required to make. The school had to limit the amount that it could take. Then, if there was construction involved, if there were modifications to buildings, there would be all kinds of problems as to what they were authorized to do, who would pay it, out of what funds.

Construction funds, incidentally, constitute a sore spot because of the distinction that is made.

Then it would be the question of what people would be on the program, the keeping of time records and the auditing, and going back and reauditing some years later; a school never knew whether it had so many dollars or something else because of a succeeding auditing and renegotiation of overhead rate. All of these things caused handicaps.

Representative PRICE. Would some of the redtape involve restrictions imposed upon people participating in a research problem by too much direction?

Mr. PARSEGIAN. No, not too much direction. The Research Division of the Atomic Energy Commission has been very careful on that point. This has been done very creditably by them. The research that was undertaken was not directed, certainly, but also in many cases it was not informed to the extent it might have been on the part of the investigator.

Representative PRICE. Would you think that the universities throughout the country would have much more to contribute to research in the thermonuclear program than they are now contributing?

Mr. PARSEGIAN. Yes, sir.

Representative PRICE. What are the restrictions on the university? Why could they not participate in basic research of their own in this field?

Mr. PARSEGIAN. In the first place, there would be some question as to whether they could have access to the information without specific authorization. There are not many schools that would ask for specific authorization and the necessary controls that would go with it.

Secondly, there would be the serious question of whether they could afford to get into it, since this will cost money. Any project in this area is likely to cost money. It takes time for the faculty members to get into the problem to learn the details in order to define some specific program they might undertake themselves.

Representative PRICE. Have there been any universities desiring to get into the thermonuclear research that have not been allowed to get into it?

Mr. PARSEGIAN. I am not aware that any have been denied access. However, speaking for my own school——

Representative PRICE. Let us put it another way. Have any expressed an interest in the program that have not been encouraged to get into the program?

Mr. PARSEGIAN. I do not know any who have actually made such an expression. However, I am afraid they are simply discouraged from trying it, as in the case of my own school.

Representative PRICE. Do you know any specific individual scientists who would like to get in who have not been able to participate in the program?

Mr. PARSEGIAN. We have a faculty member who has been trying to get authorization for access to the thermonuclear literature on the campus.

Representative PRICE. Has this scientist made formal application for such information?

Mr. PARSEGIAN. We have made formal application; yes, sir.

Representative PRICE. Has your application been acted on one way or another?

Mr. PARSEGIAN. I think it has been under consideration for quite a few months.

Representative PRICE. How many months?

Mr. PARSEGIAN. My guess is that we started this maybe 5 months ago.

(NOTE.—Mr. Parsegian later determined that the RPI application had been made on May 31, 1957, but denied September 26, 1957, on the basis that RPI did not qualify under the revised criteria set forth in sec. 25.15 of 10 C. F. R. 25 as amended August 15, 1957.)

Representative PRICE. You want to receive this information because your institution would like to conduct some basic research into the problem on its own, or is it in the nature of seeking a Federal grant to conduct research on the program?

Mr. PARSEGIAN. It would be both, but, first, we would have to know what there is there that we would want to get into. Tnen we would propose a program that might be supported. It turns out, incidentally, that a man on our faculty is closely informed on developments in that area, but not while he is on the campus.

Representative PRICE. What would be the reason that he would be closely informed on developments in that area?

Mr. PARSEGIAN. From past connections.

Representative PRICE. From past connections?

Mr. PARSEGIAN. Yes.

Representative PRICE. But he does not now, as a member of your faculty, have access to information in the program?

Mr. PARSEGIAN. He has been attending meetings on thermonuclear subjects when these meetings have been called. But there has been difficulty in getting authorization to have literature sent to the college so that others might also participate.

Represenative PRICE. Is it the feeling of yourself and your faculty that, if given access to available information, there would be something that you could contribute to this program?

Mr. PARSEGIAN. Yes, sir, providing we can afford to.

Representative PRICE. Would that be true with many other universities' scientific faculties?

Mr. PARSEGIAN. I am sure it is so.

Representative PRICE. Have you ever heard it discussed in scientific circles along that line?

Mr. PARSEGIAN. I think, sir, if you had been at the physical society meeting recently, when a session was devoted to this, and if you were to observe the excited interest that there is in the subject among physicists, I think the answer would be that there is a great deal of interest that needs to be cultivated.

Chairman DURHAM. I asked the question yesterday, why we did not declassify all of this field. I will ask you the same question. Do you think it ought to be declassified with no security involved? I am speaking of the controlled thermonuclear.

Mr. PARSEGIAN. Would you like me to answer that, sir?

Chairman DURHAM. Yes, sir.

Mr. PARSEGIAN. I think it is simply that we have not yet developed the guts to get out of the old rut.

Chairman DURHAM. That is based on the fact that the knowledge is pretty well known in all the other countries at the present time. So, what are we locking up?

Mr. PARSEGIAN. Yes, sir.

Chairman DURHAM. I have felt the same way you do for quite a while. Certainly, some areas should be restricted because security is involved. Do you think this is growing worse or better? We have declassified a lot of material, as you know, in atomic energy.

Mr. PARSEGIAN. Yes.

Chairman DURHAM. We had to pull a lot of teeth to get it done, but we made a lot of progress in that field. Today we have declassified thousands and thousands of documents which a few years ago were stamped "Secret" by somebody who wanted to put something in the file quickly.

Mr. PARSEGIAN. I think there are two basic obstacles. One is the tenor and spirit of the act itself, which at the moment still seems to assume that atomic energy is a thing restricted to the United States Government, and with tolerance toward bringing in others on occasion. I am afraid, sir, I must say that the spirit is still that. It permits control to that degree.

Secondly, even if the rules set up by the Classification Office were as liberal as we are led to believe they are, the interpretation of these rules, going all the way down the line to the tens of thousands of people who originate documents, and the tendency on the part of people to play safe and classify and overclassify—all of these tend to continue the problem and make it worse than the rules would necessarily require that they be made.

Chairman DURHAM. I think there is another matter which is serious, and that is the fact that free discussion by you people who have superbrains is of great value in the field of basic research. Is that having an effect on the present field of basic research.

Mr. PARSEGIAN. Applying it to atomic energy on our campus, we offer 16 graduate courses having to do with the various aspects of atomic energy. Some of these try to be quite advanced, like advanced nuclear metallurgy, thermal stress analysis of nuclear systems. However, invariably, each becomes a course where one tells what has been done. One does not come to grips with the latest developments in the field. So, free discussion is limited to free discussion of what someone chose to give us to discuss. That, sir, is not the kind of thing that will grow properly as basic research in a university atmosphere.

Chairman DURHAM. In other words, we put a tool in one of our laboratories that costs $4 million or $5 million of taxpayers' funds and that is confined to a certain area, and a few individuals have that knowledge which would be of great value if spread over the whole field.

Mr. PARSEGIAN. I might give another example. Under sponsorship of the Atomic Energy Commission, we are developing a subcritical reactor design which utilizes a pulsed neutron source. Incidentally, we have great confidence in the value of such a tool for colleges in contrast with some other training devices. We learned that a similar subcritical assembly with pulsed neutron source had been used in a national laboratory with rather interesting results. The thing was much more useful for analyzing reactor behavior than we had at first been led to believe was the case.

We invited the man who had done that work to come to Rensselaer to give a talk on the subject, and the physics department, electrical engineering department staff, and others were there.

In the course of that discussion, I asked the speaker the simple question: "What was the neutron flux that you used in your experiment?"

He replied, "That is classified information."

Representative PRICE. Doctor, before I yielded to Mr. Durham, you mentioned a meeting of a large group of scientists who were discussing the desirability of getting into the controlled thermonuclear program. Were these people all people outside of the program at the present time or did it include some who are in the program at the present time?

Mr. PARSEGIAN. There were people who are in the program at present.

Representative PRICE. Did they have the same feeling on the matter of declassification as the others?

Mr. PARSEGIAN. I have not talked to them lately. I used to be involved with them when they deplored this secrecy, but I have not talked to them in the past couple of years.

The ones who were excited, and clearly showed it, were people outside the program.

Representative PRICE. There have been statements made by responsible people within the controlled thermonuclear program to the effect that they believe that every scientist who had something to contribute in this field and who had expressed a desire to participate in this program has had the opportunity to do so. Do you think that is a factual statement?

Mr. PARSEGIAN. First, sir, I do not know how anyone can dare to make the statement that everyone who had something to contribute had been heard from.

Representative PRICE. Then you would say that is not a factual statement?

Mr. PARSEGIAN. I am afraid I must say that, sir, because ideas spring from unusual places and from unexpected quarters.

Representative PRICE. Do you personally know, without naming people, of scientists who are interested in this area of controlled thermonuclear who have expressed interest in the program and who have not been able to get into it?

Mr. PARSEGIAN. Last year when I appeared before you, I quoted the MIT reservations about getting into this work because it was classified. So for 2 years the MIT people stayed out of it.

At the present time I understand they are involved in it but on a rather limited basis because of the classification.

Representative PRICE. That is all, Mr. Chairman.

Chairman DURHAM. Are there any further questions?

If not, thank you very much, Doctor. We appreciate very much your coming down.

Mr. PARSEGIAN. Thank you.

Chairman DURHAM. The next witness is Mr. Jerome Luntz, editor of Nucleonics.

STATEMENT OF JEROME D. LUNTZ, EDITOR, NUCLEONICS, ACCOMPANIED BY JOHN E. KENTON

Mr. LUNTZ. Thank you, sir.

Mr. Chairman, I appreciate your kind invitation for me to testify in the 202 hearings.

My name is Jerome D. Luntz. I am the editor of Nucleonics, a publication of the McGraw-Hill Publication Co. I have been with Nucleonics for the entire 10½ years of its existence.

The principal part of my statement will be on item 2 in the list of suggested topics you provided with your invitation. This is the subject of atomic power. In addition, I will comment on item 4, fusion.

First, with your forbearance, I would like to repeat a statement I made in the 1957 202 hearings. I do this to point up the fact that there has been no real improvement in the situation mentioned since last year.

> Because we in the United States are at a crucial point in the growth of our atomic-energy industry and in the development of related policies, it behooves us to do right now what should have been done some time ago; namely, set clear-cut goals on where we want to be going. What do we want to achieve domestically and when? What do we want to achieve internationally and when? An elaboration of the latter question is, what do we mean by world leadership in atomic energy? Obviously, the answers to these questions should provide the guidelines for future activities of both Government and private industry.

Although very considerable technological progress has been made in the United States nuclear power program in the past year, we have still not come to grips with our need to devise an imposing, dynamic and dramatic program that will truly serve the international needs of the United States. These international needs are now even greater than before because of the recent highly publicized achievements of other countries in science and technology.

I firmly believe that we can easily make use of our excellent capabilities in atomic energy to recoup some of the face that we have lost in the world. But, if we are to do anything, it must be done immediately.

Before commenting on the civilian power program, I would like to go on record as supporting the legislative proposals made by Senators Anderson and Gore and Representatives Durham and Holifield on the role of the Atomic Energy Commission in the development of nuclear reactors for space vehicles and rockets. With the likelihood that nuclear energy will be important for such purposes, there is little question but that AEC and the atomic-energy industry could do the best job in the shortest time on the nuclear machinery. Both the talent and the facilities are available, and there need be no interference with the civilian atomic-energy program. In fact, as has been shown clearly in the nuclear Navy program, there should be great benefit to both efforts, space and civilian power, by concentration under the AEC umbrella.

On the civilian power program, international considerations—the need to establish and maintain world leadership, the need to be able to offer other countries concrete assistance—demand a much larger effort on the part of the United States. Because the motivation for doing this is a Government policy consideration, obviously it should be the responsibility of the Government to see that money is made available for carrying it out.

There seems to be little doubt in the minds of most people in the atomic energy field on both these points—need for larger effort and need for Government support.

To get a clearer picture of this, Nucleonics has just completed a survey of the atomic-energy industry. A summary of the results,

prepared by John E. Kenton of the Nucleonics staff, is attached as a part of this statement. Because most of the key people in the field were contacted in this survey, I feel that the results are an accurate reflection of the thinking of the industry as a whole.

Among other things, the survey clearly shows support of the need for the United States to be the world leader in atomic energy and of the consequent need for the United States program to be accelerated. However, implicit in the results, in the form of the top score for "diversity of types of power reactors being studied or experimented with" as a criterion of world leadership, was a belief that the basic course of action in reactor development followed by the United States thus far has been the correct one. The respondents apparently felt that diversity of approach is still important for the United States.

But with the presumption that foreign policy goals will be imposed on the domestic program, the respondents recognize the need for increased research and development, and for the development of exportable technology.

Perhaps the most interesting result of the survey was the clear-cut desire and need for subsidy on the part of industry, subsidy of research and development and fuel costs. A lesser majority favored subsidy of capital costs.

Interestingly, if there is to be a subsidy, both the utilities and the manufacturers felt that the utilities should be the ones to be subsidized.

The results of the survey are tabulated on the second page of the attachment. I shall be happy to elaborate on any part of it.

I would like to mention here for the record that the small table that appears on the final page of the survey has a typographical error. The heading for that table should read "Anticipated nuclear equipment imports."

Representative HOLIFIELD. Which column does that apply to?

Mr. LUNTZ. That applies to all three columns.

Representatives HOLIFIELD. That all goes together?

Mr. LUNTZ. That should be the title of the entire table.

With the assumption that some form of acceleration is to be striven for and that the Government will support it in some manner, the knotty questions are:

What kind of a program should be developed and how should it be carried out?

Answers to the first question are made easier when a time factor is introduced.

In our survey, Mr. Durham's proposal of last year that there be a 10-year program was essentially supported. Presumably, AEC could extrapolate its present reactor program to cover a 10-year period in such a way that, by 1968, the United States should have pretty good indications of which reactor types will produce competitive power in the United States and which will not. Similarly, as a by-product of this effort, but in a shorter period of time, data will be developed that will be useful to our foreign friends.

On the matter of how to implement any new program that is devised, we should not lose sight of the fact that nuclear power is very important to the United States, domestically, right now. In the near future it will have an even greater domestic importance. Certainly as soon as nuclear power becomes competitive within the United States, it will be a vital force in our economy.

This, then, makes it important for us to realize that policy decisions that are made today are as important in determining the future framework of United States atomic-energy development as were both the McMahon Act and the 1954 law.

The ambitious program that needs to be initiated calls for the closest coordination between Government and industry. We need to have a strong governmental setup for the advanced thinking necessary as the underpinning for our atomic economy. We need to have a strong nuclear industry for the carrying out of applied technology. Both have a vital role to play.

It should be expected that over the life of, say, a 10-year program, some ideas will evolve that will look more interesting than they did at the outset. Other ideas, including certain reactor types, may look less interesting as time passes. This suggests the need for flexibility in the whole approach.

There should be no fear of abandoning ideas or projects if they prove to be uninteresting from the economic or technical point of view. We should not wed ourselves to any particular reactor or approach just for the sake of having one of that particular kind. We should be looking for sophisticated and useful results.

The overriding influences on whatever course of action is followed are:

1. A specific objective must be achieved, including, in part, the building of certain kinds of reactors; and
2. A strong and efficient nuclear industry must be fostered.

The first objective is not in any way incompatible with giving industry a major role in the building of reactors called for under a new program. Industry can make major contributions to achieving the desired time schedule and to reducing nuclear power costs.

The Government should not foot the entire bill. Rather, industry should be given incentive to spend its own money backed up by some form of subsidy that would be justified by the international considerations involved.

Perhaps some sort of an approach as the following should be considered:

In a program devised by AEC in consultation with industry specialists, it might be decided that certain facilities and projects should be undertaken. Industry should then be given the opportunity to take on the ones that were of an "industrial" type. An arrangement would have to be worked out where the Government would pick up a percentage of the costs involved.

Industry would only take on projects where it felt it would be agreeable to taking risks beyond commitments made by the Government. Where no industry takers were available, and this would have to be determined in a reasonable, short period, the Government would handle the job in question.

Because the goals of the program should be tied directly to the national security of the United States, in that the program would be an implementation of foreign policy, industry, as a partner of the Government, would feel just as motivated and obligated as the Government to stay the route in any project it undertook. Of course, as pointed out before, there should be some basis for agreeing on stopping projects where experience warrants it.

In whatever is done, I would like to underscore the vital need for there to be spelled out what the time scale will be and what the magnitude will be of any effort devised, and what the respective roles of Government and industry will be.

Before leaving the fission-power program, I would like to point out two other things. One place that we fall down in our dealings with other countries in atomic energy is that we in the United States do not speak with one voice to our friends. Most importantly, the respective roles of the Government and the industry are confused in the minds of people from other countries. I suppose this stems, in part, from the contrasting situation in England where the governmental atomic body gets behind its industry to the extent that when potential customers come along, there is little question in the minds of the customers that the industry will be backed up in the fullest manner possible. Warranties on reactor fuel performance are one example.

Another and different kind of thing where the United States Government-industry partnership needs to be borne out is at the forthcoming Geneva Conference. It needs to be made fully clear there in our presentations that both the Government and the industry in the United States have activities and capabilities that are important.

In view of the remarks that Mr. Durham made this morning, I would like to make the comment that I am concerned about the showing of the United States at Geneva. I think we have gotten started, unfortunately, a little bit late in trying to set up some sort of coordinated program, and I believe that in part the unfavorable comparison of 80,000 to 28,000 square feet of the United Kingdom and United States exhibits, respectively, stems from that.

Representative PRICE. Was that Geneva or the Belgium World Fair?

Mr. LUNTZ. Geneva.

Another comment I would like to make is related to the McKinney panel report.

When that study was carried out in 1955, it was found, I believe, that insufficient availability of information on fission reactors was a deterrent to industrial participation. It may be of interest to the committee that this no longer seems to be a problem. AEC has done a fine job on declassifying information. Any company that has an interest in atomic energy need no longer have any difficulty getting the information it wants.

I hope, Mr. Chairman, you will not consider it immodest of me to interpolate here that I believe that Nucleonics has been serving part of this function of disseminating information to the nuclear industry.

Chairman DURHAM. You have done a fine job.

Mr. LUNTZ. Thank you, sir.

My final comments are on the fourth item on your suggsted list of topics—fusion. I would like to provide for the record, if I may, an editorial that I wrote for the February issue of Nucleonics.

One of the most humiliating examples of the harm that secrecy can do came last month on the simultaneous release of fusion data by the United States and the United Kingdom. It was demonstrated very dramatically that scientific research that has great potential for peacetime application cannot be bottled up by classification with the expectation that undistorted, unpressured, normal scientific activities can still be carried out.

Instead, there is a spiraling buildup of false hopes among outsiders, technical and nontechnical, and even among insiders, about the significance of every bit

of progress made along the way. Those working on the project feel these pressures and frequently find themselves striving for unrealistic goals.

This was what happened in the field of thermonucleonics.

Work on fusion was originally classified for two reasons: military and, reportedly, economic. In the latter case, some felt that a tremendous new economic force might be produced and that we should not tip our hands to others.

In the military justification, it was stated by AEC that "it appears that any thermonuclear reactor will be a substantial neutron producer capable of producing substantial quantities of special nuclear material."

Now, last month, a first step in declassification of fusion data has been taken that essentially says that the economic argument for secrecy no longer makes sense because of the long-term nature of the development. And also that there is less reason for the military argument, which is borne out by the fact that the information released gave great emphasis and details on the production of neutrons.

In the meantime, however, harm has been done to the program and to the morale of scientists working in it. The Americans suddenly found themselves thrust into a situation where they were overtly competing with the British. The Harwell team had last summer produced what it thought might be thermonuclear neutrons. The scientists had the desire to publish their results. At least some Americans felt that if there was to be any publication, the United States should have thermonuclear neutrons to talk about also. And so the rush was on to do just this.

While this behind-the-scenes race was going on, the impression became current that the British had achieved a major breakthrough.

Then came the anticlimatic bilateral announcement last month that both countries thought they had produced thermonuclear neutrons. Although very impressive and important scientific work has been done on both sides of the Atlantic, there is real doubt that any milestone has been achieved that will go down in history as has the discovery of fission and the development of the first self-sustaining chain reaction. Nor is there even any evidence that the development of a thermonuclear reactor is assured.

Although the scientific papers released clearly show that neither the United States nor the United Kingdom is further advanced than the other, one thing that is clear is that the spectacle that both teams have just gone through—the scientists, the administrators, and the policymakers—was a humiliating and disconcerting one, one that needn't have been except for the secrecy that covered the work. Were it not for secrecy, presumably the work would have been reported on in a normal manner in scientific circles as other science is, and there would have been no psychological buildup to the point where an "event" had to be created as an occasion for the release of data.

Unfortunately, the United States may not be seeing the lesson inherent in the present situation and may be building up to another let-down at the Geneva Conference later this year. Apparently considerable additional fusion data is being withheld for Geneva with the hope of making great impact there. Once again, the scientists must "produce."

Whenever we engage in scientific olympic games of this type, we can't help but inflict requirements upon ourselves that may hurt us more than they help us. Science should be conducted in an atmosphere of free and open inquiry and results should be reported as normal progress warrants.

One additional comment.

Progress in fusion in the United States will be hastened with the participation of many more groups than are now involved, both university and industrial groups. Two things are needed to accomplish this: Removal of secrecy, and a deliberate policy by AEC to encourage participation.

I think perhaps in large part one of the things that has interfered which increased participation by outside groups has been what I would call the lack of an encouraging environment.

In addition, I would like to support Senator Gore's proposal that fusion work be accelerated. Here is a field where success lies in the future.

There is ample time, if a decision is made soon enough, for the United States to mount an aggressive attack on the major technological problems and, with good hope for success, to demonstrate to the world by action that the United States is, in fact, the world leader in developing peaceful uses of science and technology.

Thank you, Mr. Chairman, for the privilege of appearing before your committee.

(Reprint from Nucleonics is as follows:)

[From Nucleonics of February 1958, vol. 16, No. 2, pp. 17–21]

ACCELERATION, SUBSIDY BACKED BY ATOM LEADERS IN SURVEY

STATEMENT OF OBJECTIVES HELD A PRIMARY NEED, NUCLEONICS FINDS; WIDE ACCEPTANCE SEEN FOR PRINCIPLE OF FEDERAL FINANCIAL AID

How survey was made

Four questionnaires were drafted, two each for domestic and for foreign interviewees—one consisting of yes-no or short-answer questions, the other of 2 or 3 very broad and searching questions. The forms were sent to Nucleonics' correspondents in United States cities and 11 foreign countries, with instructions on whom to interview; a handpicked group of top atomic leaders—about 85 Americans and about 50 abroad. The results were collated by Nucleonics' editors in New York.

The Nation's nuclear power program should be accelerated, and more money is is indispensably required from AEC if this end is to be accomplished, a preponderant majority of key United States leaders in the major branches of the atomic industry believes.

The first need is for a clear-cut definition of United States objectives in the field, which is felt to be lacking at present.

The principle of a subsidy now receives wide acceptance in the private atomic industry—much wider than the word itself (which some consider a "dirty word," preferring to call it "assistance" or "financial participation"). Semantic questions apart, an overwhelming majority think AEC should help industry by greater support of research-development work; almost as many would like to see a subsidy on fuel costs, and a narrower majority favors subsidy of capital costs.

The purpose of acceleration is to attain economic nuclear power as quickly as possible. Many leaders recognize that for reasons of United States foreign policy it has become desirable to achieve economic power from the atom as soon as possible even though abundance of fossil fuels does not yet make this vital in the United States.

As to the route to economic power: a decisive majority considers construction of full-scale reactors [50 Mw(e) or over] desirable; an even much greater majority favors construction of smaller reactors. Half the respondents favor construction of both pilot and full-scale plants.

There is general agreement, even among utility men, that kilowatts alone are not enough.

Abroad, the United States can look to solid markets for reactor equipment, components and materials for 10 years or longer, according to most respondents; but the outlook for export of entire power reactors is less bright.

These are among the most important disclosures of a Nucleonics survey, just completed, of atomic industry leaders in the United States, and 11 foreign countries. At home, the survey covered the views of atomic industry leaders among equipment manufacturers, privately and publicly owned electric utilities, architect-engineering firms, and reactor experts who advise the Government on nuclear power technology. Abroad, in addition to manufacturers, utility executives, and scientists, the survey also sought the opinions of the leaders of governmental atomic programs.

The latters' replies revealed that—although, as has frequently been said here, most countries plan to build their own power reactors as soon as they are able—they expect to be importing reactor parts for 2 to 20 years from other countries, and see the United States as a source of supply. In terms of money value, estimates of likely reactor-equipment imports ranged as high as $40 million by 1960, $200 million by 1963, $325 million by 1968. These high estimates were from Germany and Japan primarily; much more modest, yet not insignificant

amounts were cited in Belgium, Italy, Sweden, Switzerland and elsewhere. (Details of the foreign survey will be found starting on p. 20.)

Back in 1953

When the Joint Committee on Atomic Energy was holding hearings in the summer of 1953 on whether or not to revise the Atomic Energy Act of 1946, many of the same problems were already vexing the industry. Even then, 28 of 38 witnesses (NU, September 1953, 11) including the then newly named AEC chairman, Lewis L. Strauss, declared that the urgency of developing nuclear power was great. And on the question "Who should be responsible for engineering and building civilian power reactors?" 5 of 38 said it should be primarily the Government; 8 felt it should be primarily industry, and 15 favored joint Government-industry responsibility. After 4½ years of accumulating experience and greater sophistication in nuclear power, a majority of industry leaders still feel that the program is not moving fast enough. But where barely 1 manufacturer raised his voice in favor of Government development subsidy in 1953, that view has changed notably over the last 5 years as industry came to understand better the problems in achieving economic nuclear power.

Also in the intervening years, nuclear power has become, for better or worse, an instrument of foreign policy. So it was not surprising that in Nucleonics' survey there was a quite close correlation between the majority favoring acceleration of our nuclear power program and the majority that feels it is important for the United States to be the world leader in nuclear power. And even among the half-dozen who said "yes" to acceleration but "no" to the importance of world leadership, several said it was obvious Congress was determined to do all it could to assure United States leadership; that, therefore, however they might feel that this was not essential, they were proceeding with the questionnaire on the assumption that this effort would be made.

As with "subsidy," there were some demurrals over the word "acceleration" as implying ever-increasing speed, or as being too closely identified with the Gore bill; "expansion" or "broadening" were suggested.

Among seven suggested criteria of world leadership in nuclear power, the choices of the industry leaders emerged clear-cut: "availability of exportable technology" and "diversity of types of power reactors being studied or experimented with" received overwhelming approval as being important criteria, with "availability of exportable reactors" close behind. The other four all received a thumbs-down reaction, with "kilowatts of capacity planned" trailing furthest behind. Two other criteria suggested were "the most advanced technology," and "operating cost of reactors."

On financial support

An interesting gulf developed in the replies to the questions on whether AEC should spend more money on power reactor development and on construction. An overwhelming majority favors AEC spending on development—and wants to see increased AEC support of work done by national laboratories and AEC's direct contractors—but a very much reduced majority wanted AEC money going for construction. Many stipulated that they favored AEC construction spending in support of industry-controlled projects, but opposed any further AEC power plant construction. On this, as on a few other questions, the opposition of the privately owned utilities made itself felt.

Results of Nucleonics survey on United States reactor program

[NOTE.—First number represents "yes" answers, second number the "no" answers, throughout]

	Totals		Equipment manufacturers		Utilities [1]						Architects-engineers		Reactor advisers [1]	
					Total		Private		Public					
1. NATIONAL POLICY OBJECTIVES OF THE UNITED STATES IN ATOMIC ENERGY														
(a) By whatever standards you use, do you think it's important for the United States to be the world leader in the field of nuclear power.	64	8	18	3	25	3	18	3	7	0	16	2	5	0
(b) By whatever standards you use, do you think the United States nuclear power program should be accelerated?	58	14	19	2	18	10	12	9	6	1	17	1	4	1

See footnotes at end of table.

Results of Nucleonics survey on United States reactor program—Continued

[NOTE.—First number represents "yes" answers, second number the "no" answers, throughout]

	Totals		Equipment manufacturers		Utilities [1]						Architects-engineers		Reactor advisers [2]	
					Total		Private		Public					
(c) Do you think the following are important as criteria of leadership:														
Number of power reactors in operation?	33	36	12	7	7	21	3	18	4	3	11	7	3	1
Number of power reactors under construction and/or contracted for?	28	38	10	8	5	22	4	17	1	5	11	7	2	1
Size of power reactors being planned?	28	37	9	10	10	16	6	14	4	2	7	10	2	1
Kilowatts of capacity planned?	17	49	8	11	7	20	1	19	6	1	2	15	0	3
Diversity of types of power reactors being studied or experimented with?	67	5	16	3	29	1	23	0	6	1	17	1	5	0
Availability of exportable reactors?	54	14	16	3	19	9	15	7	4	2	17	1	2	1
Availability of exportable technology?	65	3	18	1	18	0	22	0	6	0	17	1	2	1
2. FINANCIAL SUPPORT OF THE FIELD														
(a) Do you think AEC needs to spend more money on power reactor development?	64	7	16	3	27	2	20	2	7	0	17	1	4	1
(b) Do you think AEC needs to spend more money on power reactor construction?	40	29	15	4	13	17	8	15	5	2	9	7	3	1
(c) If so, should AEC increase its support of work done by its national laboratories and its direct contractors?	42	16	11	8	17	3	11	3	6	0	11	5	3	0
(d) Should AEC subsidize industry in the building of power reactors:														
By increased support of research and development work?	62	8	15	4	27	2	21	2	6	0	16	1	4	1
By subsidizing fuel costs?	57	12	15	3	22	1	21	1	6	0	12	6	3	2
By subsidizing capital costs?	42	26	14	5	11	16	6	15	5	1	14	4	3	1
(e) If there is a subsidy, who should get the subsidy:														
The manufacturer?	26	33	6	11	8	12	6	8	2	4	9	9	3	1
The customer (public or private utility or other industry)?	50	7	15	4	19	0	14	0	5	0	14	2	3	1
(f) If there is to be a subsidy by AEC, who should determine how the money is to be spent:														
AEC?	54	11	12	6	23	1	17	1	6	0	15	3	4	1
The recipient of the subsidy?	33	21	10	7	10	9	9	6	1	3	10	4	3	1
(g) In connection with the export of reactor equipment, should the United States Government offer subsidies on power reactors?	34	30	10	9	13	11	10	8	3	3	9	7	2	3
(h) If previous answer is "yes," who should be subsdized:														
The United States firm?	23	6	7	2	8	1	6	1	2	0	7	2	1	1
The foreign customer?	12	11	4	3	1	6	1	5	0	1	6	1	1	1
3. ACCELERATION OF THE REACTOR [3]														
If the United States power reactor program is to be accelerated, how should it be done:														
By building large reactors (above 50,000 kilowatts)?	39	21	11	4	15	9	10	8	5	1	9	8	4	0
By building small reactors (below 50,000 kilowatts)?	54	7	15	3	22	0	17	0	5	0	15	2	2	2

[1] Survey was sent to all private and public utilities with a record of interest in nuclear power; number of respondents in the 2 groups is to be compared with national installed capacity: 97 million kilowatts for private, 12-million kilowatts for non-Federal public.

[2] Not all answers received are tabulatable as this group of scientists frequently departed from questionnaire to answer in their own terms.

[3] Last parts of this question, not easily tabulatable, asked how many and what kinds of large and small reactors should be built how many kilowatts should be installed, if kilowatts were considered important; and what the time scale for acceleration should be. See main story for replies.

Of three possible places where a subsidy could be applied, all received favorable majorities, but again sharply differentiated: a preponderant majority welcomed the idea of AEC subsidizing industry in building power reactors by giving greater support to research-development work; a smaller majority favored subsidy of fuel costs. ("Yes; subsidized fuel costs, if it means fuel development," said a manufacturer. "Yes, under proper safeguards," said a public utility man. "Yes; for a period of time," a manufacturer. "Yes; reduce—not subsidize—fuel costs; subsidy as such should be avoided," a private utility leader. "No; present fuel costs are enough of a subsidy," a manufacturer. "No; this falsely influences plant design—rather subsidize operating costs in general," an architect-engineer. "No; it would tend to perpetuate uneconomic fuels," another architect-engineer. "Can't answer, because what is a realistic fuel cost?" a private utility man.)

A sharply reduced majority came out in favor of the third alternative suggested, subsidy of capital costs. Here again the private utilities made their weight felt. Said one manufacturer: "No; if capitalists can't supply capital, it's tough."

About 40 percent of the respondents would have AEC give subsidy in all three areas. One at least would restrict subsidy to a separate program of development for export reactors. Several spoke approvingly of a formula—one that Lawrence R. Hafstad proposed in 1954 when he was AEC's director of reactor development—under which AEC would underwrite the difference in cost to a utility between a nuclear plant it might build and a conventional station of equivalent size that it would otherwise have to build.

Who gets it?

Most of the leaders queried were willing to have the reactor customer get the subsidy, if there is to be one; far fewer favored giving the subsidy to the manufacturer. Said one manufacturer in the minority opposed to subsidizing through the utility: "He'll get his plant, but we won't necessarily get to economic power. Through the manufacturer you are more apt to attain your goal." There was a general feeling, on the other hand, that a subsidy paid to the utility would permit it to pay a viable price to the manufacturer for his hardware and that in this way the subsidy would reach both parties.

"He who pays the piper calls the tune" still applies, even in this realm, and on the question of who should determine how subsidy money is to be spent, "AEC" was the prevailing choice. "It's not the way to do it, but it's the way it will be done," was one hard-headed comment. However the number of stipulations urging "joint determination" ran high.

Whether the United States should offer subsidies on export of power reactors came out statistically almost even. Here there appeared to be a feeling that this was a foreign policy operation, coming under the foreign aid program, and that if subsidy were felt necessary, it should be handled by the State Department. A program is offered by one manufacturer who feels it would be inappropriate for the Government to subsidize export of capital production equipment: "In all probability, the export market for power reactors could be opened up for American companies if the Government would guarantee for a period of say, 20 years (1) price and availability of enriched uranium; (2) price and a market for recovered plutonium; (3) availability of capacity and guaranteed charges for reprocessing; (4) liberal financing arrangements."

In considering the time scale for acceleration, 10 years came out far in front—the same period of time that JCAE Chairman Durham is urging as the duration of a new reactor demonstration program (NU, December 1957, 18).

One veteran manufacturer proposes a 10-year program having as its goal construction of 4 large plants averaging 200 Mw. (e) each year for 5 years for a total of 20 reactors. Because of the long development fabrications and construction cycle, completion of the program would take about 10 years. A capital subsidy of $100/kilowatt installed would, it's felt, give the private and public utilities adequate incentive to proceed with such a program, giving the United States 4-million kilowatt installed nuclear capacity at a cost to the Government of $400 million. "The chances are excellent," says the plan's author, "that such a program would result in attainment of economically competitive nuclear power by the end of the period if the program is concentrated in the area of a very few reactor types"—those where the technology is best known and understood. For this reason emphasis is placed on the light-water-moderated reactor; however a few of other types such as liquid metal cooled or gas cooled might be included. Likewise, the program should be concentrated "on reactors of very large size

because of their superior ability to reach competitive costs in a minimum time. Undoubtedly it will be desirable to authorize a few reactors of smaller sizes to meet special purpose requirements."

Another top manufacturer, who feels the national goal should first be defined in terms of a time scale and a program then worked out to implement it, suggests for it achievement of economic power in industrialized foreign countries in 5 years and in the United States in 10. Government should help industry, but not subsidize it entirely.

What should Government do?

A wealth of data was turned up by the survey's final questions, open questions on what ought to be done in the nuclear power field in the next several years. Some of the salient suggestions as to what the Government should do were these:

More vigorous support of research and development, especially on fuel elements and reprocessing.

Establish long-term national objectives [these two were mentioned most frequently, and then always first].

Establish the level of Government support for the next several years [the need for a program of almost any determinate number of years, and the great handicap in a long-range development field of working under the usual congressional system of year-to-year appropriations came out strongly].

Establish long-term prices for nuclear materials under Government monopoly.

Enlarge the present program for testing safety characteristics.

Assist industry on some formula that will give an incentive to keep cutting costs (see box p. 20).

Establish fair contract procedures, and cease asking for contributions from industry for the benefit of Government projects [this from a bystander not involved in the Elk River miscarriage].

Elimination or modification of such official or unofficial Government concepts such as giveaway closed-end commitments by AEC, at least to the extent of protecting industry from open-endedness on joint projects, full cost recovery for AEC services to industry when both have common objectives; assurance against abandonment particularly when economic justification (in the sense of value of experience relative to its cost) for carrying a project to completion cannot be assured at outset. In this last connection, many pleaded for more flexibility in programing to permit changing course as experience dictates.

Abolish the 20-percent enrichment limitation on fuel exports, which implies that we don't trust our allies while at the same time it doubles costs for fuel fabricators because 20 percent alloy is so brittle the rejection rate is high.

Improve AEC contract administration.

What should industry do?

Most frequently mentioned were: perform more research development, build more reactors, continue to develop promising reactor concepts, concentrate on getting costs down. Other points:

Industry should bid on projects on a fixed-price basis to gain incentive for cutting capital costs.

It should adopt profitable pricing policy that will not involve substantial losses merely because of desire to break into the field. Pricing below cost is causing uncertainty and chaos among firms trying to develop stable markets.

The equipment industry has been too quiet about the business problems it faces in establishing a sound basis for the future, should make the community more aware of its problems.

Operate more realistically regarding costs and dates of completion.

Steer clear of the public versus private power quarrel. This is stated by utility people as well as those in other groups.

Some contradictions

Contradictions should be expected in any survey such as this, but a few gain significance because of the persuasiveness with which the conflicting opinions are set out, and the standing of the men behind them. Samples:

One reactor type will eventually prove to be the best, and we should concentrate on finding it. It's likely that different reactors will have different applications for different purposes.

We should have a broad approach and not concentrate—we should concentrate on the types now furtherest developed, to hasten the arrival of competitive nuclear power, while continue to develop more advanced types.

While most favored increased support for work done in national laboratories, one comment was that support of development work should be fed through existing utility industry and major equipment manufactures; if Government goes on spending money on Government labs for this purpose, "the experience and knowledge will reside in Government organizations, not in commercial firms." Said another, "I think we'd get more for our money in this sort of development program than $300 million at the national labs. Where all information becomes general, you eliminate competition."

Subsidy plan suggested in form of tax rebate

An intriguing plan for a subsidy to industry, with no cash handout and with built-in incentive, was offered in the Nucleonics survey by Leo Davenport, president of Sylvania-Corning Nuclear Corp. The plan: for the Government to offer tax rebate and special depreciation allowances for accomplishment in nuclear plant construction.

Philosophically the plan is straightforward, Davenport says; taxes are the dues we pay to the Government (representing the community) for the privilege of working in the United States; if the Government wants certain people or companies to do something for the good of all, it makes sense to have the Government offer to reduce dues in return for effort by the firms.

Incentive would be provided by prorating the tax rebate for accomplishment. The Government-industry contract covering a joint project would specify $X worth of tax rebate if the plant were completed for $Y per kilowatt installed capacity. If the plant were built for less, the tax rebate would be proportionately greater; if the company failed to meet its target cost, its reward would be less, likewise on a graduated scale.

MARKET SURVEY ABROAD BRINGS SURPRISINGLY OPTIMISTIC RESULTS; MANY SEE IMPORTS FROM UNITED STATES OF WHOLE REACTORS AS WELL AS PARTS

A surprisingly optimistic forecast—optimistic from the point of American would-be reactor exporters, that is—was registered by respondents abroad in Nuclenonics' survey.

That a nearly unanimous "Yes" should be registered to the questions, "Do you expect your country to import equipment, components, or materials for power reactors from other countries in the next several years?" and "Do you expect your country to import these from the United States in the next several years?"—this should be cause for satisfaction but not surprise, unless for its near unanimity. But that, to the same pair of questions applied to whole power reactors instead of equipment, components or materials, replies should be evenly split—this was quite unlooked for. That half the respondents—particularly considering their stature in their countries' nuclear programs—should expect a market to develop for entire United States reactors seems more optimistic than might have been foreseen. Having obtained its interviews on a strict basis of no identification, Nucleonics must protect the anonymity of its survey respondents, and has to content itself with a flat assertion that they are top responsible officials.

Those who answered "Yes" to any of the first four questions were asked for how many years they judged they would be importing such things. This brought a range of 5 to 12 years and a median of about 7 for whole reactors; a range of 2 years to indefinitely and a median of about 12 years for components and equipment. Predictions of long-term import postions came from Belgium, Germany, Switzerland, Italy, Sweden, Brazil, and Japan. Declining to hazard predictions were respondents, in France, Netherlands, Australia, and Mexico.

Lastly, the short-answer questionnaire asked overseas respondents what monetary magnitude, in round numbers, they expected their nuclear equipment

imports to have in the next 2, 5, and 10 years. Their estimates fell within these ranges (in millions of dollars).

Country	Anticipated by 1960	Nuclear equipment by 1963	Imports by 1968
Australia	1–2	10–40	20 to >40
Belgium	Up to 6	12–15	Up to 60
Germany	15–40	50–200	100–200
Italy	1–15	50–150	100 to >150
Japan	22–30	39–190	60–325
Sweden	—	Up to 1	Up to 5
Switzerland	1–5	5–20	10–50

Obviously, these are guesses. But they are guesses by sophisticated people, in many lands, speaking with authority and with no incentive to give other than their undistorted opinions. If they are well founded, they may portend a broader and more solidly founded market for United States manufacturers than some have feared.

The French, as they see themselves, are in a special position. They feel they have a fairly sophisticated nuclear industry and that there is no reason why it could not handle France's needs. Three years ago France would have been interested in buying whole reactors, but since then she has developed her own technique and made her own fuel supply arrangements (plutonium) that led her in a direction away from that chosen by the United States. Says an industrialist, "We don't wish now to drop all our work, which we think is valid, and adopt a system in which we have practically no experience, a system, moreover, that uses a fuel over price and supply of which we have little control. Furthermore we think your nuclear costs are perhaps higher than your estimates indicate, particularly on capital costs." Authorities involved in the Chinon reactor project, France's first civilian nuclear station, speak of power costs as low as 8–10 mills/kilowatt-hours. A French CEA official sums up the reactor import situation as "Too little and too late."

Importing: Influences * * *

The free-answer questionnaire summed up the field in two questions: "What factors are influencing your country's decisions on matters related to importation of nuclear reactors and reactor equipment?" and "What obstacles if any are there to your country's importation of reactors and reactor equipment from the United States.?"

The first question brought answers that were just about what might have been expected: cost of equipment and favorable financing terms; reliability; fuel availability and assurance of continued fuel supply; lack of domestic experience (Italy); imports a means of catching up with countries more advanced in atomic energy (Germany and Japan); earthquake-proof reactors (Japan); extent to which native industry can participate in construction power plant (Netherlands).

* * * *and obstacles*

The question about obstacles to importing United States reactors and equipment, however, yielded some noteworthy comments.

Lack of United States sales effort was reported by several Australians independently. Said an Australian scientist: "British seem to be ahead of the Yanks in this field and they are doing more to keep us informed and interested." An Australian utility man: "We seem to hear more from England and they appear to be more interested in us as customers." An Australian industrialist: "Frankly, no Americans have ever called on us but the British have been trying to sell us on the advantages of their equipment." The dollar shortage was also mentioned by two Australians.

From Japan there is also a persistently-recurring theme: that the British have a working nuclear plant, the United States does not (so it is stated). "Lack of United States experience in producing power reactors, while the British have actually turned out a working model. It's believed cost of production with United States enriched-uranium reactors would be 10–20 percent higher than with the British Calder Hall. In any case, Calder-type costs can be calculated today, while United States reactor costs are still uncertain." "United States

cannot yet show Japan a power reactor actually in operation." "As United States atomic power development has not yet reached the stage of commercial application, it is difficult to judge the economic and technical aspects of United States reactors. The diversification of reactor development in the United States has left an impression of confusion in Japan, especially in view of the fact that the British now have a working power reactor." It may be hoped that the entry into service last December of the AEC-Duquesne Light Co. PWR will mitigate this impression.

Other obstacles cited in Japan bear on enriched uranium—its higher cost, and dependence on a single source of supply for it. This point was made, also, in Brazil and elsewhere.

Said a German: "So far, obstacles and difficulties in cooperation with the United States have been of minor importance. However, after the events connected with the RWE project, we are expecting certain obstacles with delivery of enriched-uranium fuel elements." [The events alluded to are the collapse of negotiations between AEC and AMF atomics for construction of the Elk River reactor, and AEC's alleged consequent refusal to license export of the identical RWE reactor without prior testing of the oxide fuel elements in the United States. (NU, November 1957, 19). AEC officials in Washington told Nucleonics this was a "misconception" on the part of the Germans; that AEC has no licensing control over AMF's activities; that there is no licensing procedure for export of fuel, and that no reactor license was involved as substantial fabrication overseas was called for.]

The one single obstacle most often mentioned was, of course, high costs. Others: Insufficient information on costs of fuel, reprocessing and refabrication, and waste disposal (Germany); insufficient information on design (Italy); lack of guaranties on burnup, fuel supply, buy-back price, chemical reprocessing, and inventory charges (Italy); high labor costs (Sweden); requirement for inspection of spent fuel elements and their return for reprocessing to the United States (Sweden) [no longer required—another misapprehension].

Chairman DURHAM. Thank you very much. We are always glad to have you with us. You have given us a good statement for thought.

Mr. LUNTZ. Thank you.

Chairman DURHAM. It outlines some of our problems as you have always done in your publication. We are always glad to have them.

Representative PRICE. Mr. Luntz, on page 5, where you suggest that no industry takers are available on a given reactor project in the power-development program, within a reasonable short time the Government could handle the job in qeustion, what would you consider to be a short time?

Mr. LUNTZ. This is something that I have felt would have to be considered very carefully. I do not know if I can pull a number out of the air, but I suppose if I were to, the kind of number I would choose would be something of the order of 3 to 6 months. I must say I lean toward the lower of the numbers, 3 months.

Representative PRICE. A year or more would be something that would interfere with an orderly program?

Mr. LUNTZ. I believe so.

Representative PRICE. It would be a handicap in the acceleration of the program if it went beyond a year?

Mr. LUNTZ. I think so.

Representative JENKINS. As one member of the committee, I would encourage men of the stature such as this gentleman in their cooperation with this committee, and in that way with the Government

Representative PRICE. Mr. Chairman, I would like to ask another question.

In your experience in gathering news, and you are more or less a news gatherer in this field in the promotion of a trade journal—I guess the finest in the nuclear field, knowing no comparable organ—

have you found much complaint in regard to the difficulty of capable and competent scientists participating in the controlled thermonuclear program?

Mr. LUNTZ. I have come across several situations where organizations that have wanted to participate have had considerable difficulty in arranging that participation.

Representative PRICE. Did these organizations make offers to participate?

Mr. LUNTZ. Yes.

Representative PRICE. Did they express a desire to participate?

Mr. LUNTZ. Yes.

Representative PRICE. On the basis that they felt that they had something to contribute to the program?

Mr. LUNTZ. Yes, indeed; very highly competent organizations.

Representative PRICE. Substantial organizations that had laboratory facilities available and competent leading scientists within their organizations?

Mr. LUNTZ. Yes, sir.

Representative PRICE. That is all I have, Mr. Chairman.

Chairman DURHAM. Mr. Holifield.

Representative HOLIFIELD. Thank you, Mr. Chairman.

Mr. Luntz, you have apparently arrived at a position where you believe that a subsidy is necessary for the acceleration of the civilian reactor type of industry?

Mr. LUNTZ. Yes; that is correct.

Representative HOLIFIELD. You have not always taken this position, have you?

Mr. LUNTZ. I have not taken a position opposite to that.

Representative HOLIFIELD. In some of your editorials, I thought you had been a little bit critical of the majority of this committee when we were trying to accelerate the civilian reactor type program. Your magazine took some pretty stiff digs at some of us people here that were trying to push this along.

Mr. LUNTZ. I believe, Mr. Holifield, the position that I have stated, both before this committee and in editorials, has never included a statement in opposition to subsidy. I have disagreed with some of the views that have been expressed by the committee in the form of legislation, but this did not relate to the question of subsidy.

Representative HOLIFIELD. You say, interestingly, if there is to be a subsidy, both the utilities and manufacturers felt that the utilities should be the ones that should be subsidized. Do you take that position, also?

Mr. LUNTZ. I should point out that what I am reporting on in that particular sentence is a result of a survey.

Representative HOLIFIELD. Was that the Arden House conference that you are speaking of?

Mr. LUNTZ. No. This is the Nucleonics opinion survey which is attached here.

Representative HOLIFIELD. Your own survey?

Mr. LUNTZ. That is correct.

Representative HOLIFIELD. Does your magazine support that, or is that just the reporting of a survey?

Mr. LUNTZ. I am strictly reporting the survey at that point.

Representative HOLIFIELD. You have no personal feelings on that point, that the utilities should be the one?

Mr. LUNTZ. I do not.

Representative HOLIFIELD. On page 4 of your statement, you say there should be no fear of abandoning ideas or projects if they prove to be uninteresting from the economic or technical point of view. Of course, you realize that, if it is a private industry project, you are advocating something there which is something that they cannot do, do you not?

Mr. LUNTZ. I am not sure that I understand your question, Mr. Holifield.

Representative HOLIFIELD. If a private industry is promoting a project, they are promoting it ostensibly because they think it is a good project. Do you think they would be as quick to abandon it from an economic or technical point of view as the Government could?

Mr. LUNTZ. I think that this is one of the risks that all groups working in the field, whether they be governmental or industrial, need to recognize. I think if we attempt to force the pattern that every project that is started must be completed we may well distort our technology by doing that. I think we may well be investing undue time and effort in things people presumably would not consider worthwhile.

Representative HOLIFIELD. You say we should not wed ourselves to any particular reactor or approach just for the sake of everything won at a particular time. Does this refer to the Commission's position on the series of pressurized-water reactors?

Mr. LUNTZ. I must say that, although I am aware of the position that you are referring to, I did not have that in mind specifically there.

Representative HOLIFIELD. You would apply it to any line of reactors following one particular type of approach?

Mr. LUNTZ. I would, indeed.

Representative HOLIFIELD. In other words, you think there should be a varied approach in the field?

Mr. LUNTZ. I do, indeed.

Representative HOLIFIELD. Of course, this is the position that the committee has taken right along.

Mr. LUNTZ. I understand that.

Representative HOLIFIELD. We have advocated that a wide approach be made, not only in the types of reactors and promising or radical types, but we have also recommended that a series would have to be built before we could find out the real value of them.

Mr. LUNTZ. I think this is a very good approach.

Representative HOLIFIELD. Including gas cooled. I remember the committee took a strong stand on gas cooled. If I remember reading your magazine, you rather thought that was a type that should not be explored.

Mr. LUNTZ. No, sir; I did not feel that was a type that should not be explored. What I felt was that my understanding of what was being sought by the committee at the time I wrote the editorial was that the committee was seeking for the United States to build a Calder Hall of reactor.

Representative HOLIFIELD. It was clearly said time and again in the testimony—not the testimony—in the questions of the committee,

that the committee never advocated a duplication of the Calder Hall. We advocated the building of a gas-cooled natural uranium type of reactor, but we specifically said in many instances that it was not to be a duplicate.

Your magazine and other parts of the press misrepresented the position of the committee time and time again, saying in a snide sort of way—not in your particular article, but the press—that all we wanted to do was to waste money to build an uneconomic reactor as the English have at the present time. The committee never asked for that. They asked that this theory be explored and that we take the technology which the British had developed and use that as a base and go from there and try to produce a reactor which could be sold abroad to foreign purchasers who did not want to obligate themselves to enriched fuel.

Mr. LUNTZ. If I may say this, Mr. Holifield, my own view at that time and for some months before that was that it was rather important for the United States to pursue natural uranium reactor systems. I did not oppose that particular idea.

The full impact of what you have just said did come out rather clearly in the hearing that the committee held in September of that year. I must say that this was the first place that I found in the record a full statement of this.

Representative HOLIFIELD. I think you will find it in the debate on the floor when the legislation was proposed. I think you will find it there, also, at an earlier date.

Representative PRICE. And in the committee report.

Representative HOLIFIELD. And in the committee report, as far as that is concerned.

Representative PRICE. It was available for anyone who really wanted to read it.

Representative HOLIFIELD. Who really wanted to report what the committee's position was.

I hold in my hands the New York Times of Thursday, February 19, and it announces that the British will send Japan an atomic powerplant. This is a natural uranium gas-cooled type of plant and the Japanese have now decided to buy from Great Britain and they have invited the British concerns to bid as to which one will be given it.

Representative PRICE. How many kilowatts?

Representative HOLIFIELD. It says 150,000 kilowatts. The plant will have an electrical output of 150,000 kilowatts. This was announced by a Japanese mission that has been negotiating in Great Britain for a month. The mission is led by Uso Gafa of the Japan Atomic Power Co.

The decision to buy from Great Britain came in the face of reported keen competition from the United States. The sale comes on a recent contract for an English nuclear power station.

I think this is a pretty clear indication that our competitors are getting a little ahead of us. Something is wrong with our program, apparently.

You call attention in your statement here that the British Government:

I suppose this stems in part from the contrasting situation in England where the governmental atomic body gets behind its industry to the extent that when

potential customers come along, there is little question in the minds of the customer that the industry will be backed up in the fullest manner possible.

What we have been trying to do is to develop a reactor technology which will allow our manufacturers to get out and compete in the world market, and up to date it has been blocked. It has been blocked by cries of socialism and all of this sort of thing.

England goes right ahead with its so-called socialist alliance and gets the job done.

You are acquainted with the Arden House Conference, are you not?

Mr. LUNTZ. I participated in that, Mr. Holifield.

Representative HOLIFIELD. What do you think about the report of the Arden House Conference? It was a pretty notable gathering there. They came up with the conclusion that our situation over here was in pretty bad shape competitively speaking.

Do you feel the same way?

Mr. LUNTZ. My name was attached to that report, so I will say that I subscribe to the report. In fact, I must say that in my statement here and in my testimony last year, I expressed what I hope was rather strongly the feeling that a significant stepup or improvement in our program was necessary for us to meet the international challenge.

Representative HOLIFIELD. You do not think it would be socialistic for us to subsidize private industry, do you?

It would be socialistic for the Government to have built a reactor and made the technology available to all of industry without discrimination, but it is not socialistic for the Government to subsidize a particular industry and let it accumulate the know-how and possible techniques and patentable gadgetry to the detriment of the rest of industry. That would not be socialistic?

Mr. LUNTZ. I think basically our entire atomic energy program in the United States right from the start has been one where private industry has been involved in the program and those companies that have been working as contractors to the Commisison obviously made a gain in their knowledgeability in atomic energy over those who were not involved in the program.

Representative HOLIFIELD. That is exactly right.

This is the fact we realized when we placed in the law a certain protection for patent information which was to deny to those companies who had an advantage in participation the right to patent ideas or hardware to the discrimination of other American companies who did not have that opportunity. So we put a section in there to give protection to all of American industry.

This was also denounced as socialism because we did not want to allow a certain few companies to steal the technology which the taxpayers had paid for. This was denounced far and wide as being socialism. The committee was denounced for going in effect of guaranteeing that all of United States industry should have equal access to patentable technology and we would not play favorites and let 3 or 4 that had contracts get it because of the advantage of their participation.

You would still say if we subsidize a specific private industry, that would be more desirable than for us to forward this technology, as the British are doing and as the Soviets are doing, and then making the information available to all of industry.

Mr. LUNTZ. I think that the situation that we would have, regardless of how it is done, is that if Government money is involved in any particular private project, the information that is developed is available to the entire United States.

Representative HOLIFIELD. It is available if the Atomic Energy Commission steps in and claims it. But if they do not claim the information and assert a public interest in it, then it becomes the peculiar trade secrets of that company. This is exactly what has happened.

Last night we questioned the Atomic Energy Commission and they have not declared for the public interest one patent in 4 years' time. This means that there is locked up in the vaults of the companies that have been building under contract with the United States Government a great many ideas, some of which may be patentable and it is going to be very interesting to the members of this committee that tried to protect all of American industry to watch the parade that will occur at the Patent Office after September 1, 1959, if we allow this patent protection clause to expire at that time.

I prophesy that there will be a long line of patent applicants down there to obtain patents on technology and possibly hardware which they have accumulated during their experience in building reactors with taxpayers' money. This will not be socialism because it will be helping just a few. It will not be for the benefit of all the industry in the United States. Those boys who have had the contracts will have the experience and know-how to get the patents and where to get them and what to patent, and then they can charge the rest of American industry a royalty fee for the benefit of that which they obtained mainly through the expenditure of public moneys.

I hope in some of your future editorials you will take some of these facts into consideration and not be so hot on some of us people who are trying to protect all of industry in the United States and also trying to get the job done that needs to be done which things like this newsprint today shows we are not doing.

Mr. LUNTZ. I would like to say at that point, Mr. Holifield, that my personal interest and the interest of Nucleonics magazine is not in supporting the welfare of any one manufacturer or any group of manufacturers, but in supporting the welfare of the United States atomic energy program.

Representative HOLIFIELD. In one of your editorials—I do not need to read it—you said that the Joint Committee on Atomic Energy was stabbing the atoms for peace program in the back. That is not very polite phraseology. We "were stabbing them in the back." I do not think this committee is guilty of stabbing atomic energy in the back. We may have kicked them in the pants a few times.

Representative PRICE. What action of the committee was it that caused you to make that statement?

Mr. LUNTZ. I believe that specific reference was to the action in connection with a limitation on the freedom of action of the President in connection with the International Atomic Energy Agency.

Representative PRICE. That action was taken on the recommendation of the State Department. The State Department gave the committee no encouragement to act otherwise at that time.

A few of us on the committee who did oppose that particular incident to which you refer had the rug drawn right out from under us by the State Department itself.

Mr. LUNTZ. So I understand, Mr. Price.

Representative HOLIFIELD. Do you think we were stabbing them in the back last year when we put over the $3 million plutonium recycle plant?

Mr. LUNTZ. My reference was to this International Atomic Energy Agency.

Representative HOLIFIELD. This is part of the program which the committee pushed, against the Atomic Energy Commission's desires. We thought as long as a study had been made by General Electric and they thought it was feasible, and we thought as long as plutonium was going to be running out of our ears some of these days when all of these reactors get going, that we ought to find out some way of burning this as a fuel and not having it only for bombs.

We thought maybe this would further the atoms for peace idea a little bit, to learn how to burn it as a fuel.

Do you think that was a stab in the back when we pushed that program?

Mr. LUNTZ. Let me say, about 6 months to a year prior to that time, I had in an editorial suggested the need for the United States to have an important and useful plutonium program.

Representative HOLIFIELD. Did you write an editorial patting the committee on the back when they finally came around to your way of thinking?

Mr. LUNTZ. The specific answer to that question is "No," I did not.

Representative HOLIFIELD. We passed a little appropriation last year to study the gas-cooled reactor. This also was against the Commission's wishes.

Do you think that was a wise action on the part of the committee? Do you think it is something we ought to explore and find out whether it can be done or should we let England go ahead and develop the natural uranium gas-cooled reactors and get all the business in the world?

Mr. LUNTZ. To refer to the statement I made earlier, I felt previously, and I did feel at that time, that it was extremely important for the United States to have a natural uranium reactor program, and we had lagged on that very seriously.

Representative HOLIFIELD. I am glad to find that you are in accord with at least some of the action of the committee.

How about the dual-purpose reactor that we authorized? Do you think that ought to be done?

Mr. LUNTZ. Very definitely. I did not comment on that editorially, but I must say I agree with that.

Representative HOLIFIELD. I am glad to find we are in such close accord. It makes me feel good.

Representative PRICE. Mr. Luntz, concerning the incident that caused you to write the editorial accusing the committee of stabbing the atoms for peace program in the back, if that were true, then the real harpoon was slung by the State Department.

Mr. LUNTZ. I would be inclined to agree with you on that.

Representative HOLIFIELD. We always enjoy your magazine, sir.

Mr. LUNTZ. Thank you very much, Mr. Holifield.

Representative HOSMER. It appears that it stimulates Mr. Holifield.

Representative HOLIFIELD. It is a very stimulating magazine.

Representative HOSMER. Mr. Luntz, you, as Mr. Michaelis indicated, referred to the importance of leadership in the international atomic energy program. You were here this morning when the so-called wise men comment was recounted that perhaps our broad base approach to the problem was an indication of such leadership.

I would take it from what you said along similar lines that you agree with that as a criterion for leadership.

Mr. LUNTZ. Yes, I do. In fact, I might emphasize that this survey that we have just completed particularly underscores that point.

Representative HOSMER. The survey left out something that I would like your personal opinion on.

Mr. Michaelis brought it up, too; you both talk about this development of power reactors for electrical generation. I am wondering if we could not take some more limited field, for this reason:

Mr. Michaelis pointed out that Europe and Japan were the leading export markets, and they have in common a very high cost of conventional electrical power, which we do not.

In another field, all three areas, Europe, Japan, and the United States have something in common, in that they are primarily maritime.

Could it be possible that we could achieve this international prestige that we desire by making a full scale effort on maritime propulsion?

Mr. LUNTZ. I believe that the maritime activity is an extremely important activity. We do in fact have a program which has just been getting underway.

My own preference—I believe you are asking what I feel is the relationship between the 2 or the preference between the 2 would be to see us emphasize the strictly central station civilian land based application, because I think that even though the maritime application is important and may be useful, that there are restrictions imposed by the shipboard use that are not involved in the central station application that might cause us, if we emphasized that to the neglect of civilian power, to come up with a distorted technology that we would be trying to offer to the people.

Representative HOSMER. I was only trying to speculate as to some area in which we had an immediate urgency.

In connection with the article that Mr. Holifield read from the New York Times, as I recall that editorial of yours, it said something to the effect that the very raising of the argument in Congress regarding the gas-cooled reactor threw doubts as to the advantages of our own product and, let us put it bluntly, we have pressurized water reactors to sell and we are doing a pretty good job of it, and the argument about gas-cooled reactors merely throws doubt on our product and builds up our competitors.

Do you feel that argument last year did in fact have an influence on the decision of the Japanese to buy this gas-cooled reactor from the British?

Mr. LUNTZ. I do not believe that specific thing had that kind of influence. What I had in mind was that, essentially, the entire civilian reactor program that the United States has has been based

on enriched uranium and we have developed what I think is a very, very fine technology in enriched uranium reactors.

As I expressed in my statement to the committee last year, I felt then and I still feel that it is particularly important for the United States to make this technology as accessible as possible to foreign countries. One of the barriers that people in some foreign countries have felt existed is the need to depend upon the United States as a possible sole source of enriched uranium.

I have felt that there were things that the United States had to do to assure our friends abroad of the fact that, if they bought reactors using enriched uranium, their nuclear lifeblood would not be cut off.

Representative HOSMER. Am I then wrong in inferring from your article that you meant to say that the gas-cooled reactor argument in and of itself would hurt us competitively overseas?

Mr. LUNTZ. Yes. I think it is just one of a number of factors that enters into the psychology that a potential customer is surrounded with in his decision on where to purchase a particular plant.

Representative HOSMER. I understand that your statement is not intended to outline the objectives that you are urging that the United States establish, but is merely trying to lay some ground rules; is that right?

Mr. LUNTZ. That is correct.

Representative HOSMER. You have been in this field so intimately for the last 10 years, I would like to ask you a question with relation to these patents as against unpatentable know-how as an advantage to somebody that is in this field and is going to expand in the future. In your opinion, which of those factors has the greatest relative importance?

Mr. LUNTZ. I would say that know-how is more important today, because the reactors that are being built today may not be the reactors that we will be building 5 or 10 years from now. So, it is the technical competence that is developed within an organization that, I feel, is quite important.

Representative HOSMER. Does that extend to such things as craftsmanship and the fabrication of metal and the increased skills that have had to be developed in this particular industry?

Mr. LUNTZ. Yes, indeed, plus the technical guidance from the management group in a particular organization, whether it be a laboratory or industrial group.

Representative HOSMER. You say this sort of thing is relatively very much greater than the patents?

Mr. LUNTZ. I would hesitate to put a value judgment of that kind, actually.

Representative HOSMER. It is, though, a kind of advantage that, unless a company is large and well financed, they are not in a position to get, because they cannot get into the field in the first place.

Mr. LUNTZ. I believe that there are many small companies that are active and have been active for many years in the nuclear field that have established very strong positions because of the talents of the individuals in their employ.

Representative HOSMER. In a great measure, then, it often depends upon the individuals themselves who are working in the field?

Mr. LUNTZ. I believe that is correct.

Representative HOSMER. I have one question I would like to direct to Mr. Kenton, if I may, and, in so doing, I would like to say that I find that Mr. Kenton's writings in Nucleonics are much more understandable to me than most articles, and even the advertisements.

Mr. KENTON. Thank you.

Representative HOSMER. That has to do with this foreign-market survey you made, shown on the last page of the extract. Those are million-dollar amounts?

Mr. KENTON. Those are million-dollar ranges, yes, sir, of what might be anticipated.

Representative HOSMER. What those countries would buy, not within their own borders but from some outside source; is that right?

Mr. KENTON. That is right. They might import into their borders from an outside source.

Representative HOSMER. Can you give us any estimate as to the capacity of those various countries to pay, or are those imports going to have to be financed almost wholly outside of those countries, too?

Mr. KENTON. Speaking off the cuff now, I would venture a guess that most of these countries are countries with fairly strong and stable financial situations, like Belgium and West Germany and Japan, Sweden and Switzerland, that probably could afford to pay a preponderant share, if not all, of these imports.

Representative HOSMER. Then you would feel that they are real markets and not illusory markets from the standpoint of getting hard cash from them?

Mr. KENTON. I would feel these are real markets.

Representative HOSMER. You do not happen to know what arrangements either the Italians or the Japanese are making, financewise, on these purchases from the British?

Mr. KENTON. In the case of 1 of the 2 Italian plants that are being bought, I understand that they are getting help from the World Bank—the United Nations International Bank for Reconstruction and Development.

Representative HOSMER. How about the Japanese?

Mr. KENTON. The other one is privately financed by a syndicate in which 55 percent is owned by Italy's largest utility, the Edison-Volta Co., and the rest is made up by shares held partly by private firms and partly by Government-sponsored firms in Italy.

Representative HOSMER. Is there not an application for an International Bank loan, too?

Mr. KENTON. On the Edison-Volta, there may be. I am not aware of it.

Representative HOSMER. Thank you.

Thank you, Mr. Chairman.

Chairman DURHAM. Thank you, Mr. Luntz, for your testimony.

Representative HOLIFIELD. May I ask one question, Mr. Chairman, before Mr. Luntz leaves?

I was just glancing through the extracts from your survey here, and you took up the matter of Japanese thinking. I find there you gave a number of reasons why Japan was considering the British reactor instead of the United States. One was the British having a working nuclear plant and the United States does not, and the lack of United States experience in producing power reactors while the British have

turned out a working model, and the cost of production of the United States enriched-uranium reactors would be 10 to 20 percent higher, or you believe it would be, and the fact that they could calculate Calder Hall type costs while United States reactor costs are uncertain.

You go on down the line; another obstacle bears on enriched uranium, its higher cost and dependence on a single source of supply. This point was also made in Brazil and elsewhere.

Do you or do you not believe that probably this 1 factor, the factor of not being dependent on 1 source of supply, was an important factor in the Japanese consideration?

Mr. LUNTZ. Of course, I do not know what the actual reason is. I would make a guess, based on previous studies that we have made of this, that this is an important factor.

Representative HOLIFIELD. The committee, in wanting to produce a gas-cooled natural uranium type, had this in mind, because many foreign people had said to members of this committee that they did not want to tie themselves up to dependence on a single source for fuel.

We thought, in place of putting all of our money on just 1 type of fuel, that we should be able to offer the 2 models and let them take a preference between the 2. This is why the committee has said that we should not confine ourselves strictly to the enriched fuel, not that we didn't think that the enriched fuel would probably be the best in the long run, but in order to have a line of goods to show we should not sell ours completely out of the market by not meeting the competition of a particular type which did seem to have an appeal to some of the foreign nations.

It is my personal opinion that this is one of the real factors which has given the English a little bit of advantage over us. They could sell an automobile that could gas at any filling station while the automobile we were offering used a certain type of gas and we were the only ones that had it for sale.

That is all.

Chairman DURHAM. Thank you very much, Mr. Luntz.

Mr. LUNTZ. Thank you, Mr. Chairman.

Chairman DURHAM. The next witness is Mr. Philip Powers, president of Internuclear Co.

STATEMENT OF PHILIP N. POWERS, PRESIDENT, INTERNUCLEAR CO.

Mr. POWERS. Thank you, Mr. Chairman.

Chairman DURHAM. Mr. Powers, you may proceed with your statement.

Mr. POWERS. Mr. Chairman, I appreciate very much the invitation to appear before you today, and I sincerely hope that the views which I shall express will be helpful to your committee.

I am president of the Internuclear Co., located in Clayton, Mo. This is an engineering consulting firm in the nuclear field, which a group of us formed more than 2 years ago. Prior to that, I had been director of the atomic project for the Monsanto Chemical Co. for several years, going back into the early industrial participation days. When Monsanto decided to discontinue its atomic power studies in 1955, several of us decided to form this company.

Representative HOLIFIELD. At that point, has Monsanto bowed out of the atomic picture?

Mr. POWERS. Yes.

Representative HOLIFIELD. This is news to me.

Mr. POWERS. Yes; they decided to emphasize their application on chemical applications rather than power.

Representative HOLIFIELD. I can remember reading an article by Mr. Charles Thomas at the time we were passing the 1954 act in the American Weekly where we were going to be frying eggs with atomic electricity.

Mr. POWER. At that time he was very enthusiastic in participating in the power aspect, but later on he found out that it made more sense to emphasize the chemical applications because of the character of their company. I am sure I should not speak for him, but this is my impression as I recall it.

Representative HOLIFIELD. Thank you.

Mr. POWERS. One of our main purposes is to help in the dissemination of nuclear know-how for peaceful applications, particularly in the power reactor field, to other parts of the free world. We have avoided any manufacturing connections in order that we may provide such information to foreign clients on a completely impartial and unbiased basis.

During the last year I spent somewhat more than half of my time abroad—mostly in Europe, but also in Japan—trying to learn the needs for nuclear technology and equipment, the places where these needs are most urgent, and the obstacles to nuclear power development.

Therefore, Mr. Chairman, it is the subject of international aspects of the atomic power program on which I feel best informed and on which I shall submit my opinions in this statement.

As an example of my contact with the problems of nuclear power development abroad, I shall mention one job that Internuclear Co. is doing at present in Italy. We have seven engineers there on a job which began last April. We are helping an Italian utility company in connection with its plans for building and operating a nuclear powerplant of approximately 150,000 kilowatts of electrical capacity.

We are helping to choose the site, to select the type of reactor best suited to Italian requirements, giving consideration to reactor types on both sides of the Atlantic, and we are then to help in the negotiations with suppliers of equipment, in the supervision of construction, in startup, in training of operators, and the like.

Thus far, we have spent most of our time on the site study and on preparation of the tenders which have been submitted to a variety of companies located in five different countries. At present we are squeezing into these consultant activities an intensive reactor engineering training program, which is being attended by 40 to 50 engineers from Italian utility companies.

The name of the company which has employed us for all of these purposes, as you probably know, is Societa Elettronucleare Nazionale, or more simply known as SENN located in Rome. You may be interested to know that the leader of our group over there is Dr. Marvin Fox, formerly Director of the Brookhaven reactor and now a vice president of Internuclear.

Mr. Chairman, I wish to emphasize the importance of American initiative and leadership in the development of atomic power in other parts of the world. It is my observation that many people in foreign countries recognize without question the preeminence of the United States in the nuclear-weapons field, but they are unfortunately not so sure about American leadership and ability in the peaceful field of nuclear-power development.

They know that a great deal of reactor research and development has been done in the United States, and they are much impressed with the successful application of nuclear power to submarines, but there are doubts in their minds as to the present usefulness of all this American technology in meeting their particular requirements for atomic-power development.

Insofar as this is true, insofar as American reactor know-how is not adapted to the needs of other countries, we are failing in providing the leadership which we have promised and which we have led other countries to expect.

The fact is that, so long as we do not enjoy the same respect and confidence in the area of nuclear power that we do in nuclear weapons, our standing abroad as a peaceloving nation is damaged. To improve this state of affairs is a major challenge to the planning of the United States atomic-energy program. There should be no more dilly-dallying in the establishment of policies which will rapidly bring the United States into a position of firm leadership in the nuclear power field throughout the world.

There is a second major reason for turning more of our attention toward the requirements of atomic-power development in other countries, and that is that some of them really need atomic power. This is not just an exercise in who can be the most peaceful. In Italy and Japan, as well as in England, a new and cheaper source of fuel is a highly urgent matter.

They must find out—and they are going to find out—what is the best way to meet their expanding power requirements with maximum efficiency and lowest cost. For the other countries in Europe, the situation is not much different, and this means that the atomic power objectives, such as those set up by Euratom, have a great deal to do with the future strength of Europe, and for us to be able to provide leadership and assistance in helping to meet those objectives is, therefore, certainly in our interest.

There is a third reason. These other countries can become an excellent proving ground for the development of our own atomic power industry. With experience abroad in the near future, during the period when atomic powerplants are more expensive than conventional plants, we have an excellent opportunity to learn how to build and operate these plants more cheaply, thus becoming better prepared for the day when rising costs of coal, oil, and natural gas will make atomic power more urgent for us as well.

The question, of course, is how this state of affairs can be improved. Basically the answer lies in an examination of the problems and requirements—the facts of life, if you please—of atomic power development in these other countries. Then the focus of American power reactor development should shift from trying to solve our difficult domestic problems to the solution of these overseas problems, and I

suspect that we shall find these problems to be simpler than those we face at home.

One of the tough questions faced by our friends abroad is to decide whether to use natural or enriched uranium. You and your committee, Mr. Chairman, are, I know, well aware of this problem because of the emphasis during this last year which you gave to the study of natural uranium reactors in this country.

You may, however, be interested in a comment made to me by the chairman of one of the large Japanese utility companies, a distinguished and able gentleman. He said to me that he knows that the urgency of getting some other source of fuel in Japan is going up every day and that atomic power appears to be rapidly becoming a necessity. But he went on to say that, so far as he is concerned, his company will never spend one yen on a reactor which depends for its fuel on some other country with a monopoly in the supply of that fuel.

He was referring, of course, to enriched material, and I thought that he was going to explain about the possible risk of the United States cutting off the supply at some future date. But no, that is not what he was going to say. He went on to explain that the thing that really worried him about the monopoly was the control of the price.

He said that, so long as there is no free market, there is no way of knowing what the material really costs and of being sure that the United States would not at some point drastically increase the price of this material, thus upsetting his return on a very large capital investment.

Representative HOLIFIELD. At that point, you can realize that if we can enforce upon the world the buying of enriched fuel reactors, we could also monopolize the sale of reactors. If we could enforce upon the world by developing an economic reactor, this would put the other people that produce reactors in the shade.

Mr. POWERS. I think that is true, Mr. Holifield.

Representative HOLIFIELD. Except that I do not believe it will work because I believe that too many of the people will be like Mr. Japanese man was. They are not going to stick their heads in that kind of noose.

Apparently, that was his idea. I might want to buy his gasoline at different filling stations.

Mr. POWERS. The main worry that he was expressing was that the price might go up radically without his knowing about it ahead of time and making plans for it.

Representative HOLIFIELD. We would have every reactor purchaser by the throat if they could only get their enriched fuel from us. It is too much to expect from human nature to put their heads in that kind of noose.

I am not saying that we would exercise that monopoly, but it is a cruel world that we live in and we have known of cases where people who had monopolies did overcharge.

Mr. POWERS. Yes. I am not sure that it is possible to completely reassure our foreign friends on this point so long as American gaseous diffusion plants remain the major source of U–235, but it would certainly help to provide some guarantees on cost as well as availability

over a period of time which is at least comparable to the amortization period—perhaps 15 years would be adequate.

A second difficulty which we must recognize is the high price of capital in many countries. This means that one way to be of great assistance would be through permitting uranium to be leased instead of requiring that it be sold. It seems to me that since we have a a mechanism for leasing uranium to United States utility companies, we surely ought to be able to work out satisfactory machinery for doing it abroad.

A third problem area lies in the determination of fuel costs. Under present policies it is difficult, if not impossible, for a prospective operator to know just what his total fuel charges are going to be. Chemical processing costs represent the most important example, but there are also lesser items such as costs that may be incurred by the Commission as a result of activities conducted to safeguard U–235 distributed abroad, transportation costs, and insurance charges in transit.

All such items should be pinned down somehow as precisely as possible instead of being left open-ended.

One way to simplify this picture, which I would like to offer for your consideration, is to calculate the credit for returned fuel elements on the basis of a very simple direct formula which would absorb most of these uncertainties. It could not be 100 percent accurate, but as time goes on, the accuracy would improve.

The formula would state simply that the credit for returned fuel elements is to be the calculated value of the U–235 which remains plus the calculated value of the plutonium which has been produced, multiplied by some factor obviously less than one which is calculated to make allowance for reprocessing costs and as many as possible of the other Government charges.

In other words, the net credit would be equal to $(A-B+C) \times$ (factor) where A is the value of the original U–235, B is the value of that which has been consumed, and C is the value of the plutonium.

To be able to calculate costs on the basis of such a formula would be a tremendous improvement, and any slight temporary inequities, resulting from inability to make exact calculations, would be offset by the advantages to be gained.

A fourth difficult area is in the field of liability insurance coverage. It would be of very great significance indeed if the United States indemnification policies covering extreme nuclear incidents to the extent of $500 million could be applied to American-built equipment which is installed in foreign countries.

Finally, may I remind you that some of the toughest problems lie in the area of fuel costs. Much additional research and development of fuel elements is needed, and there should, therefore, be expanded emphasis on Government support in this area, not only in the national laboratories and Commission contractor facilities, but also for fuel element research and development carried on by manufacturers, and utility companies, in connection with specific projects, including the foreign.

I am thinking primarily about giving a boost to overseas atomic power development, but at the same time this will go far toward pushing our domestic program as well. This emphasis on fuel element development is a good example of why I believe that the best way to give

strength and direction to the overall domestic atomic power program is to focus its attention on and orient it toward meeting the immediate requirements for nuclear power development abroad.

The five problem areas which I have mentioned are those in which I feel that the United States could be of much greater assistance, but I do not mean to paint too black a picture. As I explained at the outset, people in these other countries have doubts about the present state of United States reactor technology, but they are for the most part, still uncommitted.

The job with SENN in Italy is of special importance for this reason. The procedure which we and the Italians are following is such that there will be by far the most thorough investigation of the relative merits of different technologies that has ever been made.

The ground rules in this instance will, of course, be Italian. But during my recent visit to Japan, I found a tremendous interest in this SENN project. Again and again I was asked questions about it because they knew that Italy has to face the question of whether to buy reactor equipment for this reactor from Europe or from the States, and in Japan, they have the same problem.

As you know, we have frequently been told that the Japanese have already decided in favor of an English reactor, but so far as I know, this has not yet been formalized.

I understand that there was a statement today which Mr. Holifield put in the record a few moments ago, to the effect that the Japanese are now asking for bids from the English, but even in this case I have the impression that it is a long way from the requesting of bids to an actual final decision to buy a reactor.

Even in France, I find that there is developing a feeling that they must examine carefully the technologies on both sides of the Atlantic before proceeding very far with their very ambitious atomic power construction program. Specifically, I am told that the first two reactors, to be built by Electricite de France, will be based specifically on French technology, but subsequent reactors, EdF–3 and later ones, may be of any type whatever depending on which best meets requirements in France.

There is, therefore, a tremendous amount at stake, and in order to exert American leadership in getting this vast program started, it is certainly worth taking a few risks and making a few guesses.

May I thank you again, Mr. Chairman, for the invitation and the opportunity to appear before your committee.

Chairman DURHAM. Thank you, Mr. Powers. I might say that it is the clearest statement of facts which I believe exists, after having spent 6 weeks this year attending every atomic power program in NATO this past year.

Mr. POWERS. Thank you, Mr. Chairman.

Chairman DURHAM. Also, the fact that we are a little doubtful as to our prestige in this field. We observed that in most of those countries. I think the thing that I observed most is the fact that those countries are determined, in my opinion, to go ahead and do the job.

I do not know whether you feel that way or not. Especially France, Italy, Denmark, Belgium, and Germany, know the needs that exist in their countries and they are going to do it themselves if we do not help them.

Mr. POWERS. There is no question about it, Mr. Chairman. In those countries and in Japan, it is an urgent matter so far as their industrial development is concerned. I anticipate that it will become urgent in other parts of the world before long, but that is where the real problem is today.

Chairman DURHAM. Mr. Ramey.

Mr. RAMEY. The committee sat down with the SENN group when they were in Rome. Do you think the matter of leasing rather than selling your enriched fuel would be of help to this particular project in the sense that the bidders would be able to make more economical and realistic tenders?

Mr. POWERS. I am reluctant to make specific reference to this particular project because the whole matter is under study at the present time and there will be a report coming in the future, but certainly, in general, it is my firm impression that the companies in this country would be in a much stronger position if they did not have to ask their potential customers, in Italy where the capital costs are high, to have to raise this additional money over and beyond the cost of the plant itself.

Mr. RAMEY. How long would be the latest before an announcement about the leasing rather than the sale of material would affect tenders on this project? When would you have to have proposals in?

They would have to have some time to calculate their estimates.

Mr. POWERS. Yes. So far as this particular project is concerned, the date, I believe, for submission of bids, is April 15. A statement before that time would certainly be helpful so far as the companies in this country are concerned.

Chairman DURHAM. Looking at the economic recovery of those countries, would you place this in the No. 1, 2, or 3 category as to what it would do to affect our international relations in Europe?

Would you attempt to classify it as the No. 1, 2, or 3 project? We are spending a lot of time. What I am thinking about is that we are spending about $4 billion in this field of international cooperation in trying to secure those nations as a part of the free world.

It appears to me that this is highly important and I do not think the people of this country have thought of it so much in that way. They have thought that this is just another private enterprise and should be treated that way with very little cooperation.

The thing that worried me was that there was not much coordination in what we were trying to do there in this field. We were running it mostly through the State Department with a little help from AEC. Is that a true statement?

Mr. POWERS. I think so. I certainly agree. It is difficult for me to say what kind of things should be placed in a 1, 2, or 3 order because my own attention is focused almost entirely on the atomic power development in Europe.

Chairman DURHAM. I think of the buildup of their economy. We have used that as the main purpose in spending this large amount of money in those foreign countries every year.

Mr. POWERS. As far as I know there is nothing which we could do as far as dollars going further, than to try to help through the development of atomic power, the expansion of industrial activity throughout Europe.

Chairman DURHAM. And get them on their feet. If we have to continue to spend our billion dollars a year, I should think some of it could be wisely spent in this field.

If there are no further questions, thank you very much for your statement.

Mr. POWERS. You are welcome, indeed.

Chairman DURHAM. The committee will be in recess until 10 o'clock tomorrow morning, in room 304 of the Old House Office Building.

(Whereupon, at 4:55 p. m., Thursday, February 20, 1958, the hearing was recessed, to reconvene at 10 a. m., Friday, February 21, 1958.)

DEVELOPMENT, GROWTH, AND STATE OF THE ATOMIC ENERGY INDUSTRY

FRIDAY, FEBRUARY 21, 1958

CONGRESS OF THE UNITED STATES,
JOINT COMMITTEE ON ATOMIC ENERGY,
Washington, D. C.

The committee met, pursuant to recess, at 10 a. m., in room 304, Old House Office Building, Hon. Carl T. Durham (chairman of the committee) presiding.

Present: Representatives Durham, Holifield, Price, Van Zandt, Jenkins, and Hosmer.

Also present: James T. Ramey, executive director; David R. Toll, staff counsel; George E. Brown, Jr., and Richard Smith, staff members, Joint Committee on Atomic Energy.

Chairman DURHAM. The committee will come to order. This is a continuation of the hearings on atomic-energy development, and I believe this morning Dr. Chauncey Starr, vice president of Atomics International, is the first witness. Doctor, we are glad to have you with us.

STATEMENT OF DR. CHAUNCEY STARR, VICE PRESIDENT, ATOMICS INTERNATIONAL

Dr. STARR. Thank you, Mr. Chairman. It is nice to be here.

Chairman DURHAM. You may proceed with your statement, Doctor.

Dr. STARR. Yes, Mr. Chairman.

Gentlemen, I am pleased to have the opportunity, once again, to join with you in the consideration of the policy issues which face the atomic-energy field. It is now generally recognized that our atomic program has dual objectives—first, the establishment of a domestic industry and domestic technology which could properly provide atomic power to our country when our future needs require it, and, second, the utilization of our present leadership in atomic technology to aid now those nations of the world where power is either unavailable or of such high cost as to inhibit economic and industrial development. This international objective was established by our "atoms for peace" program and has become a significant responsibility for all of us.

Considering solely our very-long-term domestic needs, our present national program has been an adequate one. It has both breadth and depth, has been well supported by both manufacturing industries and operating utilities, and, in view of its recent inception—less than 5 years—it has been very productive of results. Our present rate of progress would undoubtedly lead to competitive atomic power domes-

tically in a decade or two, at which time it could begin to supplement our conventionally fueled plants.

It is evident, however, that the present responsibilities of the United States in the international sphere requires an accelerated effort. Most of our friends throughout the world face power needs which press them with an urgency that makes atomic power of immediate interest. They look to us for guidance and assistance. We should not fail them.

There are reports that a major atomic research laboratory has started operation in East Germany and that plans have been made there for the construction of many atomic powerplants. If we do not take advantage now of our leading technological position in this field, United States prestige might face another international shock similar to that created by the sputnik.

The acceleration of our atomic-power program has been considered by this committee in the past, and I have on several occasions been given the opportunity to submit detailed suggestions for this purpose. On this occasion I would like to discuss only the broad features of an accelerated program and their relations to our international objectives.

If I might interject a comment here, Mr. Chairman, by broad features I want to distinguish between the strategic planning for an international program and the tactical planning. What I want to discuss here is the strategic planning, not the detail of how you carry out the objective, but what the objectives should be and what we should be trying to do.

In order to accelerate successfully our technological approaches to atomic power, I have in the past indicated that our research and development program should be increased to about double its present size and be planned as a 10-year effort. This would be about a $2 billion program. Such a program would encompass all stages of development from early ideas to construction of demonstration powerplants. Until competitive costs are achieved, we must construct and operate several large plants of each promising reactor type. Such plants would be built in sequence, each containing the engineering and reactor core improvements gained from the preceding ones.

Before any such large atomic powerplants are constructed, the technical art will have been sufficiently advanced so there is no question that the plant will operate and produce power. The purpose of such large plants in the development program is to provide experience with engineering features, operating and maintenance costs, fuel cycle performance, and overall plant economics, and thus to indicate directions for improvement, both technically and economically.

This acceleration program would certainly lead to a demonstration of United States leadership in atomic technology, and would also create the basis for a strong domestic atomic equipment industry. However, the United States foreign position requires more than just acceleration and demonstration. In order to establish and maintain United States prestige internationally, the principal objective should be the construction and operation in foreign countries of atomic powerplants substantially involving United States technology, United States equipment, and United States supplied fuel. Here, however, we are faced with the limited economic resources of many foreign nations, but an unlimited enthusiasm for atomic-power programs in these countries.

Fortunately, this international goal can be accomplished as an integral part of our national planning for the development of competitive atomic power. Inasmuch as an acceleration program requires the construction of a sequence of developmental plants, it is practical to build a number of such plants abroad under circumstances which might achieve the above objective. A plan to build developmental plants abroad could thus serve both our international objectives and the orderly approach to economic atomic power. In fact, the joint participation of other friendly nations with us in the conduct of this effort may have important psychological advantages in addition to the values associated with the export of United States technology and equipment.

Such a joint-participation plan is sure to succeed if the cost to the foreign country for the electrical power generated is substantially equivalent to that expected from conventional plants in that country. This could be achieved by a two-pronged approach.

First, arrangements would be established by which the foreign participant could purchase these plants from the United States at a price similar to that for a conventional plant. The differential between the United States manufacturer's price and the payment from the foreign purchaser would be provided by a payment from the United States Government directly to the United States manufacturer. In this way the capital cost to the purchaser is made consistent with that of a conventional plant, and United States industry and technology play a leading role in bringing atomic power abroad.

In order to meet other national interests of the foreign participant, the United States manufacturer could subcontract abroad the semiconventional construction and could sublicense the manufacture of some reactor components where appropriate. In view of the ambitious program of the EURATOM group of nations, the opportunity this might provide for European industry to obtain experience by participation with United States firms would undoubtedly be readily received. The accomplishment of the atomic power objectives of many nations abroad requires such industrial assistance and this can only come from one of the countries already heavily engaged in atomic power development. This is a clear opportunity for constructive contribution by the United States.

The second and parallel action would be the provision by the United States, as part of its development program, of the fuel elements for the operation of these plants, for an extended period. The United States should maintain ownership of such fuel and sell to the user only the heat produced. This would remove one of the major difficulties in selling United States reactors abroad; namely, the uncertainty as to availability and true net cost of United States supplied fuel. The price for atomic heat would be adjusted to be about the same in cost as that from conventional fuel in the foreign country. The United States would provide the fabricated fuel, obtained from United States manufacturers, and would take the irradiated fuel back for reprocessing. The concentration of fuel element reprocessing activity under the aegis of the United States might permit sufficient consolidation of requirements to stimulate the rapid development of a chemical reprocessing industry.

As a result of these two steps, several major objectives would be achieved.

1. The orderly progress of our development program for competitive atomic power would be maintained.

2. United States support, technology, equipment, and fuel would be prominently displayed as evidence of our sincerity of our atoms-for-peace program.

3. Atomic power would be made available abroad at an early date.

4. The use of the byproducts of irradiation—such as plutonium—would be determined by the United States, as with domestically irradiated fuel.

5. In relation to indemnity abroad, United States industry could be provided protection against product liability by extension of present United States policies. Lack of such protection has been a basic block to the sale of United States atomic equipment and fuel abroad.

6. United States industry would be placed in a position to compete on equal terms in the world market for atomic equipment in all countries.

7. The United States atomic equipment industry would be strengthened by its responsibilities for these plants abroad, and thus be in a good position to serve domestic needs as these develop.

8. Permanent arrangements between United States and foreign manufacturers could be established during this period, with long-term values to our foreign relations.

9. As this program is primarily aimed at the development of competitive power, it should be expected that the supporting cost to the United States would diminish over the long term, and would completely disappear when the goal was achieved.

I have looked at the probable cost of such a program and it is quite small compared with what we are spending for the overall effort.

Gentlemen, I realize these suggestions can only serve as guidelines for a more detailed analysis and planning. If I can be of any assistance to the committee in such detailed study, I would be pleased to provide it.

Chairman DURHAM. Doctor, you have posed the question very plainly of what we are up against. You are a man of considerable experience in this field, and you played a very important part in the program of Atoms for Peace. Do you feel today that unless we take some action in a more accelerated way and outline a definite program as far as foreign countries are concerned, we are going to lose the prestige that we gained from the Atoms for Peace crusade?

Dr. STARR. Mr. Durham, I feel this very strongly. There has been absolutely no question that the United States has for many years had very real prestige all over the world in the atomic enegy field. I think that this prestige is gradually wearing away. We have what in business we call a melting asset, and it is melting at a fairly rapid rate. The real difficulty is that instead of our tackling the problem as a whole, we have been in a very piecemeal way making little steps toward solving isolated trouble areas.

I mentioned before the difference between strategic planning and tactical planning. We have been taking tactical steps. We change the price of this, we make this or that change in regulation. The

basic strategic plan of what we are trying to achieve, and how to achieve this we have not as yet developed. The absence of this has left our foreign customers in a position of not quite knowing what we are currently planning and what they can expect from us.

I might mention to the committee that I am leaving tomorrow afternoon for Europe to see certain customers with whom we have been talking regarding nuclear powerplants. I have been on other trips abroad, both in Europe and in Japan. In both these places the problems which really determine whether a sale of an American reactor is made or not is more than just a detail on the price of a specific item. It is much more a broad policy concept of what the United States is going to do in the way of supporting the foreign business in atomic power reactors. The absence of this broad strategic plan is, I think, the crucial problem which we face.

Chairman DURHAM. Do you feel that we have all the basic tools—when I say basic tools, I mean the fuel, the know-how and everything else connected with the program—if we could just have some definite plan to hang your hat on, you might say, and devise a program that would readily work.

Dr. STARR. Yes. I think we do have what is necessary to start a foreign participation in the atomic power field. The basic ingredients of this we have in hand. The one difficulty which this field has faced for many years and with which this committee, I am sure, is very familiar, is that we may have technology, we may have fuel, we may have equipment, but we do not have the development in the stage of economic self-sustaining business position. This is the difficulty we face. Under normal circumstances one could wait for this. I don't think we have these normal circumstances. We face competition both our friendly allies and by those not so friendly. We face a free world demand for action in this field. I think we are being pressed by external circumstances to do something in spite of the fact that on an economic basis solely we are not really in a business position to do it.

Chairman DURHAM. I think I agree with you all the way along the line. It seems to me we could gain a great deal of experience if we could take your suggestion to develop and build reactors over there with some support from this country in the way of fuel, or something like that, which would give us a vast amount of experience in all types of reactors for the future. That is always a selling problem, of course, in a new field of operation.

Mr. Holifield.

Representative HOLIFIELD. Mr. Starr, it is nice to see a fellow Californian back here on this spring day.

Dr. STARR. I enjoyed my walk this morning in the brisk air, which we do not have in California.

Representative HOLIFIELD. As usual, you present a very clear and orderly statement, Dr. Starr. There are some factors that we might discuss.

One factor is that the Commission has not set forth a clear goal. They are charged with the responsibility of the advance of the art in atomic energy, and as of today they have not given us the type of goal which many of the committee have felt was necessary from an international standpoint, nor has the President come out and given us this type of goal from an international standpoint. Now, the question arises, in view of the fact that the constitutional responsibility

for international relations rests in the President and his appointed administrators. What you are advocating here, really, is for the Congress to take the bit in its teeth and set up an international program which the Commission and the administration has not considered urgent enough to even send a message to Congress on. Is that not right?

Dr. STARR. Congressman Holifield, I am advocating an international program. Who sets it up, I think, is probably a matter for Congress and the Executive to decide.

Representative HOLIFIELD. Yes; I agree with you on that. There is one fault I see in your presentation here, and that is the probable cost of it to the United States. How many kilowatts would a 100-kilowatt plant produce in a year's time?

Dr. STARR. By happenstance, I happen to have such information here.

Representative HOLIFIELD. I thought you might have, being a man who prepares himself well for the job at hand.

Dr. STARR. As a general statement, I think the total cost of this program to the country would be small compared to the total research and development program that we are discussing here. As you recall, I recommended that we plan a program at about a $2 billion level for 10-year period. That is about $200 million a year. I have taken the specific example of trying to determine what this foreign-support program might come. In the case of a program which would involve building abroad five 60-megawatt reactors—electrical megawatts—and five 200-megawatt reactors, 10 reactors altogether, over a period of 10 years, it is our belief that in terms of cost in the way of capital support to pay the differential between the total cost of these plants and conventional plants would run over 10 years, $130 million. That is about 6 percent of the total expenditure that we feel is necessary for the country as a whole.

Representative HOLIFIELD. That is your differential in capital investment?

Dr. STARR. Yes, sir. In terms of what we estimate may be required to support the differential in fuel cost between their cost for conventional fuel and what it is apt to cost us if we supply the fuel, is about $30 million to supply these reactors for the next 10 years. This, again, is a very small amount compared to the total. So the whole program in rough numbers would run less than 10 percent over the 10-year period of the total national program.

One of the reasons that the costs are not excessive is that we are paying a differential rather than a total. This differential, we assume, is going to start dropping as the second, third, fourth, of any one type of plant gets into operation. We have made a guess, and I can tell you what it is.

Representative HOLIFIELD. Is this over a 10-year period?

Dr. STARR. Yes.

Representative HOLIFIELD. Is it not true that, if these countries signed up for a power-producing reactor, they would want the heat from that reactor for periods of 25 or 30 years?

Dr. STARR. That is right, sir. What happens, then, is that the fuel cost for the second decade amounts to another $30 million. But the capital costs have already been supported.

Mr. RAMEY. You figure the fuel costs would be cheaper in the next cores?

Dr. STARR. That is right. I know what I am saying to this committee is old hat to you. One of the problems on the fuel cost is the high cost of reprocessing. One of the reasons for the high cost of reprocessing is that we do not have an industry established ot get the prants going and get the systems going. We would expect over a period of the next decade or two of these costs dropping. The customer, in this particular case a foreign country, is getting his fuel on a heat basis. So he does not care what that costs us to reprocess. We have to support this differential. This differential will keep dropping as our technology in this country gets better and better. I think those of us who have seen the developments in the business are quite optimistic about getting these costs down over the 10-year period.

Chairman DURHAM. Have you given any thought to whether or not this could be done on a long-range basis under some kind of bilateral agreements?

Dr. STARR. Yes; I have given thought to this, Mr. Durham. There are certain aspects that have to do with a loan system which I feel are undesirable. They place upon the customer the requirement to find out what to do with the fuel. It is quite clear in this field that we can not make a simple loan. Whatever loan we make has surrounding it certain restrictions, certain requirements and certain unknowns of cost. To date, we have not told either people in this country or foreign groups what the cost will be to them to reprocess fuel. They have an unknown factor which they have no way of evaluating, which is completely under the control of this country, so that we can make or break almost arbitrarily the economy of their powerplants.

Chairman DURHAM. We do have such a policy in other fields with respect to loans?

Dr. STARR. Yes. I think perhaps it is the complexity in this field which makes it a little different.

Mr. RAMEY. Isn't there a policy on reprocessing now of $15,000 a day and payment of transportation costs?

Dr. STARR. Yes, except nobody quite knows how many days are going to be involved in handling any particular kind of fuel element. I think we will find when we sit down with one of the customers, as we have, and as we are going to do in the next few weeks, and try to tell the customer what it is going to cost him, then he asks, "where did you get this number," and, "are you sure that this is what it is going to cost us?" One finds tremendous gaps of uncertainty which from a business point of view I don't think the Commission can pin down. It could by fiat or an arbitrary statement of price. I think this really begs the question. I do believe that this specific kind of question is really a question of tactics. It is really a question of how do you work out the detail. I think that kind of question should be handled by people professionally skilled in the atomic-energy business. Perhaps an advising group could devise within the framework of policy set by the Government a detailed method of arriving at the strategic objectives. There is a very real danger, Mr. Chairman, in setting up a tactical decision without doing

the strategy first. I can give you an example of what I have in mind.

There has been much discussion of late as to raising the price of plutonium. There has been no statement as to why this is a good thing. I think I understand why it is permissible, but why it is a good thing has not been discussed. If it is for the purpose of making it more interesting for somebody to build atomic powerplants, then there are other ways of making it interesting. There are certain dangers in this kind of tactical approach. It may be a good thing to first analyse the overall picture.

Representative HOLIFIELD. This is a way to hide a subsidy.

Dr. STARR. Yes. But it is a situation where you make the step and then all the consequences flow from this.

Representative HOLIFIELD. For 15 years.

Dr. STARR. For example, if you make it interesting to sell plutonium to the Government, you are going to end up with reactors optimized to plutonium. This is an old argument. This committee has been through it under the dual-purpose program.

Mr. RAMEY. Is this similar to the British Calder Hall dual-purpose reactor?

Dr. STARR. Yes, that was a duel-purpose machine. In the case of the Calder Hall reactor, the production of plutonium is one of their very big returns. So you really bias the development of technology to the point where it will be for a very long time dependent upon such a high price for its continuation. What I am suggesting is that we continue with a planned program of what makes intelligent reactor development and absorb as part of our program this foreign support, and make the detailed tactical decisions as to what we do in the way of prices, regulations, and so on, as the result of a detailed study of a broad objective, rather than picking a single tactical approach and saying we are going to land the troops on this shore and then see what happens. I suggest we not do that.

Representative HOLIFIELD. I think your suggestion is very clear. As I understand your suggestion—maybe I will prove that it is not clear—the Government would process the fuel.

Dr. STARR. Yes.

Representative HOLIFIELD. Our Government would process the fuel. We would in effect furnish them the fuel on a loan basis, and we would process it and we would obtain such products as are in the spent materials. In other words, the plutonium would automatically become ours.

Dr. STARR. That is right.

Representative HOLIFIELD. So you actually have a very clear picture. Your first clearness is that if the difference between the conventional plant of this size and the atomic plant is $20 million, we pay it and that is all?

Dr. STARR. That is right.

Representative HOLIFIELD. Then in the furnishing of the fuel, they know what they are going to get because they get power at 8 mills. They get the heat equivalent of 8 mills, or whatever their standard price is in the country in which we build it?

Dr. STARR. That is right.

Representative HOLIFIELD. We assume the difference in the cost of operation and the principal part of that difference would be in the maintenance of their fuel and the processing of their fuel?

Dr. STARR. That is correct.

Representative HOLIFIELD. It is too simple. We could never do anything like that. We have got to have a 75-page contract with a lot of ambiguous language in it, and we have to hide what we are doing. We can't come out in the open. You talk like a businessman, a man who meets a payroll.

Chairman DURHAM. Doctor, at the present time do you feel the English have a big advantage over us in selling reactors in Europe? I mean in the overall operation of the plan and the way they do business?

Dr. STARR. Mr. Chairman, we find that the British as salesmen are very good and we have much to learn from them in terms of technique. Among other factors, and I think I mentioned this to the committee before, that when the British sell it is usually private British business people directly in arms with their Government. The Government takes a very direct role in any negotiation. Since their Government has complete responsibility for the fuel, the Government is in a position to make just the kind of offer in substance that I am suggesting here.

Representative HOLIFIELD. Is not this substantially the British way of doing business?

Dr. STARR. Yes. The British Government has taken the responsibility for the fuel.

Representative HOLIFIELD. They are selling the reactor on a net-heat basis?

Dr. STARR. This is what they are doing.

Representative HOLIFIELD. Getting back to your general statement, you do stress the urgency on the international level and you say that our domestic program is adequate. I suppose you mean that as far as the urgency of producing atomic power, under normal circumstances we would rock along quite slowly in this technology, and so forth.

Dr. STARR. Yes.

Representative HOLIFIELD. If we did have a vigorous program such as you advocate here, would it not solve the problem of technological advance here at home?

Dr. STARR. This would have a very, very big effect, both in speeding up the availability of nuclear power on a competitive basis domestically, but also it might be possible that the same formula which we are suggesting for abroad might be used domestically until such time as the power becomes competitive. I might emphasize again that what I am suggesting is that this be made part of our technical development program. We have to build these plants anyway. I can't speak for the industry as a whole, but I am sure you will find everyone in the atomic energy industry in agreement that we have to build multiple copies of the principal varieties which look promising, before we are going to reach the point at which they can stand on their own feet on a business basis.

Chairman DURHAM. Would you suggest in what way your plan would meet the EURATOM vision in what they plan to do the next 10 years?

Dr. STARR. As a matter of fact, when the "three wise men" were over here, Mr. Armand, who is head of the EURATOM operation has stated specifically that the one thing they needed from this coun-

try was industrial technological support. This is what they did not have in Europe. They can manufacture steel pieces. They can make pressure vessels. They have surprisingly good engineers as we are finding out in many ways. What they do not have is this tremendous backlog of technological experience which we have in this country. This is the one thing that they do want. I believe that a suggestion of this type I made here would be very happily accepted by the EURATOM group.

Chairman DURHAM. I think we saw that very definitely last fall when we were there 6 weeks visiting all the installations. I asked the question, how in the world they did that job in France, because the plant is to be built of the same material that we build plants. They said we made it all except the pumps. I said where did you get those? They said they bought them from Italy. So is the cyclotron.

Dr. STARR. Yes.

Chairman DURHAM. The tolerances were just as good as any I looked at.

Dr. STARR. Yes.

Representative HOLIFIELD. Could you tell us a little bit about the status of the organic moderated reactor experiment?

Dr. STARR. It has been running very nicely, Congressman. The machine had, as you know, one specific major purpose, and that was to determine whether the composition of the organic under radiation would be a serious obstacle in the performance of this machine. We had made small-scale tests in the MTR which had been promising, but the purpose of the installation at Arco was to make a full-scale test. We have now been in operation over a month and the power has been up to the rating of the fuel elements, and we find that the decomposition rate verifies that of the small scale test.

Representative HOLIFIELD. How large is this test you are speaking of now?

Dr. STARR. About 11 megawatts is the power level for which this fuel loading has been designed. We have been up to this power with very, very successful results. As a matter of fact, the operation has been better than we had expected on a prediction basis. We are now awaiting permission, actually, to go to higher power. I think that this illustrates perhaps another fundamental point in this field, and that is that on a technical basis it is a rather rapidly moving field.

I might recall to this committee that it was only about a year ago that the one big question on the boiling reactor, as to whether it was a good reactor, was settled, and that was the question of stability during the boiling process. After that was settled, the boiling reactor obviously became one of our principal contenders as a future reactor, the same thing is now happening on the organic moderated reactor. These early tests are answering some of the big questions and the results are now so promising that I think this is also going to be one of the very real contenders for the future.

Representative HOLIFIELD. Are you proceeding with the Piqua people and negotiating with them to build their small plant.

Dr. STARR. Yes.

Representative HOLIFIELD. Will it be this type?

Dr. STARR. Yes. We are awaiting the completion of contract negotiations with the Atomic Energy Commission. As you recall, the Joint Committee requested that these negotiations be made with the

Commission, and the difference between private negotiations and Government negotiations require some alterations in the detail. This is now taking place.

Representative HOLIFIELD. Do you feel that a large-scale plant should be constructed, larger than the plant at Piqua of this organic moderated type?

Dr. STARR. Congressman Holifield, to show you our confidence in this particular type, we have made a proposal to a European power utility for a 100 megawatt organic moderated reactor and to another one for a 150-megawatt plant. We have every confidence that these plants could be built with success. We would like to build them in this country, too. The fact, however, is that we feel that in terms of risk on technological information, that what we are getting now out of the reactor experiment substantiates the wisdom of going ahead with this.

Representative HOLIFIELD. Your Nebraska plant is a sodium type, patterned after the Santa Susana rather than this type.

Dr. STARR. That is correct. The Nebraska plant has a longer range point of view in terms of time scale. I think here again while each reactor contender has his own pet approach, there is a general agreement that if one would develop the liquid metal technologies for high temperatures that you would get more out of both fuel and reactor in the long run. This is part of the push between the fast breeder program, the liquid metal fuel reactor and the sodium graphite reactor. The experiments on the SRE are moving very nicely. We are getting a lot of technical information. The plant for Nebraska would be the first of what I would call an intermediate scale demonstration of this technology. The liquid metal field is a more difficult one technically and there is much more engineering experience required. We think in a matter of a few years this again will catch up with the others.

Representative HOLIFIELD. Your computations here are really rather modest in terms of the production of 10 of these reactors. Do you have confidence in your figures as to the differential in capital plant investment and the fuel costs?

Dr. STARR. Yes.

Representative HOLIFIELD. Are those carefully worked out?

Dr. STARR. I have made this statement before on many occasions, that the confidence in the capital costs is always higher than the confidence in the fuel cost. The capital costs are much easier to determine because they represent something on which you can get bids from subcontractors and vendors. I would say that the computation of the capital cost is a reasonably confident one. The computation on the fuel cost is our best estimate. I think it is reasonable. Even if we were off by a factor of two on this, the sum of money is still small. Again, if one wanted to sponsor more reactors than 10 overseas, you could do that.

I might point out that this adds up to 1,300 megawatts of electrical power which is about a third of what the EURATOM people are now shooting for in the next 10 years. So it is not an inconsiderable amount.

Representative HOLIFIELD. Are your computations on this available to the committee staff on a confidential basis?

Dr. STARR. I would be very happy to mail this in with explanatory comment.

Representative HOLIFIELD. I imagine you would prefer it not be published in the record?

Dr. STARR. I would prefer that simply because they are rough calculations and I think the committee staff is quite competent to use its own element of judgment in examining these details.

Representative HOLIFIELD. The only practical objection I see to your plan at this time would be that in building these plants overseas, there might be some objection to areas that need electricity here at home for this type of a subsidy. I suppose that the only way we could justify it would be on the basis of a clear statement of international urgency?

Dr. STARR. Yes. Of course, there is always the possibility that the same type of formula and same approach could be used domestically. I would urge, however, that we build these plants as part of a board technical development program, that we don't just build these plants because someone asks for them; that they be part of a planned development program. One of the strengths of our approach, and I think it would be dangerous for us ever to lose it, is the fact that we are developing multiple reactor types. As I indicated before, what looks good today is superseded by something next year. I think that as a country we would lose in the long run rather than gain by limiting our activities. Since we have these multiple types, it becomes necessary, as a national objective, to build development models of each of these types as the techology warrants. This should be done. I don't think that we should in effect overweight the program one way or another by building a particular preferential type. If one particular type already has reached the stage of economic competition, at that point the Government can step out and let normal business relations take place.

Representative HOLIFIELD. Getting away from this particular plan of yours, could I ask you this question: Since the passage of this act, has your company filed any applications for patents?

Dr. STARR. In the name of the Commission we have filed a huge number. In our own name a very limited number. The latter have been filed on work that the Commission is not supporting and does not parallel any Commission programs. But it is only a limited number.

Representative HOLIFIELD. Of course, your work has been on Commission contracts to date.

Dr. STARR. Overwhelmingly so. We have a small amount of our own privately supported work on things which we think are valuable and the Commission does not.

Representative HOLIFIELD. What do you conceive of your equity in a patent filed in the Commission's name?

Dr. STARR. Practically zero, Congressman. All we can get out of our present contract relation with the Commission is a nonexclusive royalty-free license which the Commission will grant to anybody who asks.

Representative HOLIFIELD. You have not asked for any compensation for any of these patents as provided for under the law?

Dr. STARR. That is right.

Representative HOLIFIELD. In the area where you have filed patents, these are in areas which you consider completely apart from the research and development which has been done under contracts with the Commission?

Dr. STARR. Yes. We keep a very strict segregation. I might point out that the way the patent office works in this particular field, practically any patent which we apply for in the atomic energy field, if it does not go through the Commission channels, gets referred back to the Commission for opinion as to whether it does or does not conflict with our contractual obligations. The number of patents granted is very small compared to the number applied for, but this is because of the time cycle in the Patent Office itself.

Representative HOLIFIELD. Are they put on ice awaiting the fatal day, September 1, 1959?

Dr. STARR. This is a question of definition of how cold the ice is. It takes a very long time to get a patent in this field granted.

Representative HOLIFIELD. Regarding all these patents for which you have applied, unless the Commission shows an interest in them, theoretically on September 2, 1959, can your exercise your proprietary claim?

Dr. STARR. We can exercise it as soon as they are granted on those for which we have applied and which have no connection with the Commission work.

Representative HOLIFIELD. Yes. I am talking about the others.

Dr. STARR. No. Regarding the ones that are obtained under Commission contract we at no time in the future will have any proprietary rights. The 1959 date has to do only, as I recall, with the cross-licensing. We are happy to cross-license if we have something that someone wants.

Mr. RAMEY. Has anyone applied for licenses on your privately obtained patents?

Dr. STARR. No. The only applications for which we have patents pending, for example, which I know about in detail, are the ones on these small water boiler research reactors where we spent considerable funds developing this particular piece of equipment in areas where the Commission specifically said they were not interested. We carried this on with our own funds out of our own income. We made patent applications on some of the fundamental methods developed. These are still going through the mill. But nobody has come to us and asked us for a cross-licensing permission.

Representative HOLIFIELD. Is this the general procedure in the industry?

Dr. STARR. I believe so. I think work that is done under Commission contract is at the moment wholly in the public domain. There may be a few companies that have what are called outfield rights, people who are in the pump business and who may get a contract to improve their pump for the Commission may get a right for the commercial use of that development, but these are very limited, and they are outside of the nuclear equipment. They are mostly in the fields of their own professional ordinary domain of equipment. I don't believe, frankly, that anyone in this industry looks upon his patent position as having much value either for now or the future.

Representative HOLIFIELD. You feel the know-how which you have acquired is the most valuable asset in this field?

Dr. STARR. The know-how, and I will add now more than the technical know-how, the business know-how, because it takes quite a bit of business know-how to wend one's way through all the business problems that one faces.

Chairman DURHAM. Do you feel after 1959 you will be in about the same shape as today as far as patents are concerned?

Dr. STARR. Yes. We are completely neutral. If the date did not exist, it would make no difference to us.

Representative HOLIFIELD. That is all, Mr. Chairman.

Chairman DURHAM. Mr. Jenkins.

Representative JENKINS. I have no questions.

Chairman DURHAM. Mr. Hosmer.

Representative HOSMER. Doctor, in your statement, where you talk about the Germans in the first sentence, and then an international shock in the second sentence, is there any connection between the two? Do you feel that the Germans are the ones who are coming up in this field?

Dr. STARR. You are talking about East Germany?

Representative HOSMER. Yes.

Dr. STARR. In the case of East Germany the assistance is being rendered by the U. S. S. R. It is hard to tell how much reliance to put on their announcements. There is very little question about the research laboratory going in operation. They have said that they are going to build in East Germany many atomic powerplants. They have recently announced a few more.

Representative HOSMER. At least that area is logically a showcase.

Dr. STARR. Yes. There is always the possibility, of course, that they make these statements and do not expect to carry them through. There was a statement recently that they were building in the hundreds of megawatts powerplants in Czechoslovakia and elsewhere. It was reported from Moscow, and East Germany last month that the Soviet Union plans to assist East Germany and Poland in the construction of a nuclear power reactor of about 70,000 electrical kilowatts in each country with completion scheduled for about 1960–61. The Soviet Union is reported to be assisting in the construction of a One hundred and forty to one hundred and fifty thousand electrical kilowatt power reactor in Czechoslovakia with completion scheduled for 1960. So I think it is evident that as far as maintaining our posion in this field in which unquestionably we were ahead of the Russians, we have to do something rather rapidly.

Representative HOSMER. In connection with the plan that you suggest, I would like to try to pinpoint just where the subsidy is, or to whom it is. You speak of the American manufacturers making some of their components there and subcontracting in these other countries.

Dr. STARR. That is right.

Representative HOSMER. Is the subsidy to American manufacturers? Is it to the purchaser of the plant, whether it is a private company or an overseas government or what?

Dr. STARR. There are two subsidies as such. One is to the American manufacturer in the form of a differential payment on the capital equipment. As an American manufacturer sells a plant, he sells it to an overseas buyer, to some foreign government or utility. He sells it at a price that is negotiated but approaches that of one of their conventional plants. The Government makes up to the manufacturer the difference between his price for this plant—the proper price for the plant—and the price at which he sells it to the foreign buyer.

Representative HOSMER. Then it is not the manufacturer that is getting the subsidy. It is the foreign buyer.

Dr. STARR. Yes; if you want to put it that way.

Representative HOSMER. Except to the extent that the American manufacturer is getting a profit on the subsidized portion; is that right.

Dr. STARR. Yes; I think the question of whether the payment is made to the foreign government and then returns to the American manufacturer or goes to the American manufacturer is one of the mechanics. Because of the flow in and out of the country, it would be better in this particular case if it did not go out and stayed in the country.

Representative HOSMER. You would not be quite as generous as you have indicated in these subcontracts abroad, would you?

Dr. STARR. Yes. For example, when we try to sell a plant abroad—and I do not think this would change it—we try to sell it at the lowest price that we can make it. Many items of manufacture business gets by subcontract, for example, steel pipe, pressure vessels, things of this sort. Many of these things can be made abroad at a lower cost than here. As a matter of fact, many of the national industries abroad won't buy a plant unless a good deal of the manufacture is done abroad. For example, we are considering, and so are many other American manufacturers, a proposal to the Senn group in Italy—I believe this committee has heard about this—and they are getting proposals from all over the world, from the British, ourselves, and anybody who wants to make them a proposal. In that proposal they have requested and have indicated that one of the elements of selection will be the amount of manufacturing that is done in Italy.

Representative HOLIFIELD. To provide employment?

Dr. STARR. To provide employment, to support them. Indirectly it helps us in other ways.

Representative HOSMER. How do you protect yourself in those instances? I think you ran into trouble with the Japanese.

Dr. STARR. In terms of manufacturing?

Representative HOSMER. Yes. You ran into quite a considerable amount of trouble.

Dr. STARR. This varies from country to country. I think in Italy we have contacted what we consider reliable suppliers of certain pieces of equipment. In effect, this is the manufacturer's judgment. Once a price is established and we make a poor choice of a subcontractor and it costs us more money to build a plant, at that point we would expect it to come out of our own pocket. That is our own business risk. In Italy we are selecting a group of what we consider people competent in certain areas, and in these areas we are planning to subcontract work to them.

Representative HOSMER. Do you think the United States industry would be interested in this plan of yours if the profit was based only on the part outside of the subsidy?

Dr. STARR. Possibly. I think that while profit is important, I think it is not as important in this industry today as the technical progress to reach the point where we can sell plants without having to depend on the Government. I think everyone in the industry wants to carry through the technological development to the point where these plants are economically capable of standing on their own feet. If that point cannot be reached, we ought to get out of the business. It is as simple as that.

Representative HOSMER. What is in this for the American manufacturer is largely, in your mind, experience?

Dr. STARR. There are two things. I think I mentioned both here in the paper. One is that we more rapidly move into an area of technical development of the plants. This is our principal objective in doing this and going through this foreign channel. We develop permanent foreign relations for expediting this work and for getting it done, which means as an industry we will always have a connection and always get some return out of this.

For example, this committee may know that my own company has formed a joint company with a German company, a jointly owned subsidiary, called Interatom. We will get half of the earnings of that subsidiary. This is in perpetuity. One of the reasons that the German industry was eager to do this is that we in this country had the technology and we could save them something like 5 years in getting on the market with equipment.

Representative HOSMER. That company is going to be in competition with Atomics International U. S. A. for some of this foreign market?

Dr. STARR. I think the principal problem is making the sale. I would not care whether it was done by that company or by us. As a practical matter, either way it will be known as United States technology. There is no question about this. In this particular case, if we were, for example, under this arrangement to sell a reactor in Germany, we would undoubtedly utilize that company to get much of the equipment built in Germany.

Representative HOSMER. But what if that company sells a reactor to Italy? That is two steps removed from the United States. It won't do the United States prestige any good.

Dr. STARR. They would still need our engineering and design to do it. What we have is the years of background and engineering development, and this is what, in effect, we are putting into it to support this operation.

Representative HOSMER. Is it cheaper for them to make this product?

Dr. STARR. The cost of labor in Europe is a fraction of what it is here. On the other hand, there are many things they can't make.

Mr. RAMEY. They use more labor, though, do they not?

Dr. STARR. Yes. There are many things, for example, that we would jointly work out with them to give us the cheapest overall plant. For example, stainless steel fabrication in Europe is very poor compared to stainless steel fabrication in this country, for many reasons. We would not consider subcontracting to anyone in Europe a stainless-steel fabrication. However, conventional steel products we would. Fuel-element work we would not consider subcontracting. This we would have to do in this country. There are many aspects that can be done. Routine electric motors are made as well there as here. We would divide, in effect, what gets made there and what gets made here. When you build a plant you must remember that over half of the cost of a nuclear steam installation is on the fieldwork—pouring of concrete, building of buildings, assembly of the components. This is always done by local contractors, whether it is in this country or elsewhere. So this part you subcontract. You send over engineering supervision from here, but you subcontract the work there.

We have discussed this in great detail with our European friends, and I think that this arrangement would be very satisfactory and would certainly work out.

Chairman DURHAM. That has been the pattern of American industry for many years.

Dr. STARR. Yes. This is a standard American pattern.

Representative HOSMER. I think there are some distinct problems in that. I am recalling now a paper that was delivered to the forum at the University of California Law School by one of your attorneys, pointing out such things, for instance, as contract clauses based on cost and changing cost, in which the Government artificially changes the cost to the disadvantage of the American exporter, and such things as that.

Dr. STARR. I think, Mr. Hosmer, that I have great faith in the learning ability of American businessmen on these things. I think if we get our fingers burned once on a particular contractual relationship, we will avoid it a second time. I think, as a general policy, the Europeans and the American industry, generally, would welcome this kind of arrangement.

Representative HOSMER. Do you feel that the instances of sharp dealing, such as that, would be forgotten by these countries in their overall desire to get someplace?

Dr. STARR. Yes.

Representative HOSMER. It has not in the past, from what your attorney told the forum.

Dr. STARR. Sharp dealing is something that you find everywhere. I think this depends on the selection and the atmosphere of the people with whom one works.

Representative HOSMER. I think you covered this point, but your program is 10 years?

Dr. STARR. Yes.

Representative HOSMER. But the fuel element part would be much longer than 10 years.

Dr. STARR. Yes.

Representative HOSMER. It would extend the life of the reactor.

Dr. STARR. What I am proposing is that the United States would make this arrangement. Suppose you follow this program. The United States would arrange with a particular European government or purchaser to supply the fuel for that particular reactor for a period which would represent itself reasonable amortization life on a utility accounting basis. This might be 15 or 20 years. It would do so on a sale of heat basis. The formula could be set up for what you get for the heat or a price could be established.

Representative HOSMER. In that connection, yesterday one of the witnesses told us that he was talking with a Japanese who said he would not give a yen for any part of the atomic reactor that depends on the United States for its fuel.

Representative HOLIFIELD. That is on the old basis. That is not on your basis.

Dr. STARR. Yes. I think the Japanese have considered a contractual relationship on the part of the United States or any of the companies of the United States as a pretty binding document. When I was over there we were quite willing to deal provided we could make a contractual commitment.

Representative HOSMER. On a long-term basis.

Dr. STARR. Yes. If you don't make the contractual commitment and you are not bound and at the end of 7 years or some such period you can change the price on them, they feel you are apt to do this.

Representative HOSMER. His statement, you feel, then, ran not to the United States as the source, but to the United States as a source without a long-term contract.

Dr. STARR. That is right.

Representative HOSMER. As a consequence, then, competitively we are in pretty good shape insofar as enriched fuels are concerned versus the ordinary uranium reactors.

Dr. STARR. This is a very good point. I was myself surprised to find in Europe that the European utility people and the European government people felt, much to my surprise, that they were not concerned about dependence on the United States for fuel, but they were concerned about a commitment on a very long term from the United States.

Representative HOLIFIELD. At a price.

Dr. STARR. At a price. The point they miss is that they are dependent on the United States for so much else that dependency on the United States in this particular area was not a political strain. Most of the European nations, I think, would feel that the United States is going to play a role in Europe for many years to come. They do not seem to be bothered by the idea that the United States has to supply this fuel, and they have to go to the United States for it. What they want to know now is what is it going to cost them over the lifetime of this plant. It is this commitment which they have not been able to get.

Representative HOSMER. In connection with our previous discussion about the matter of subsidy and who gets it, would you feel that section 169 of the act, the nonsubsidy provision, would have to be revised?

Dr. STARR. I am really not an attorney on this. I think probably your committee staff could tell you much more accurately than I could. As a layman reading the section, I think there would have to be some kind of adjustment made in that section.

Representative HOSMER. In your plan I could visualize these reactors going abroad, but the purchasers would be aware that it was of a new kind and that they would be taking some experimental chances. Let us put that in relation to the British coming along and saying we have a nice gas-cooled reactor, and we want to sell it to you. Where do we stand vis-a-vis that situation?

Dr. STARR. This question has been much discussed in the industry and also with the Europeans. Let me first perhaps make one point. The British are not in a position, and actually if you read the fine print of what they say, they do not say they are in a position to supply a plant whose performance is without technical risk, because they have not really built these plants yet. The Calder Hall plant is the first of an experimental type. The next one is going to be slightly different, and there are going to be problems. But I am sure that the British as well as an American manufacturer would stand behind any commitment made in getting one of these plants to work. The risk, however, you have to look at in terms of the differences between a technical uncertainty and what one might call engineering kinds of debugging. A pump might fail, and you replace it sooner. A bear-

ing burns out and you replace it. Before we build in this country a large plant, we go through the same stage we have gone through the organic moderated reactor, for example, of building a 10- or 20-megawatt experiment. We have answered the basic technical problems. The scientific uncertainties are taken out. What you are now faced with are the kinds of engineering debugging problems that go on as you go through every stage of development. Perhaps Congressman Hosmer did not buy cars in 1900, but I am sure that people who did were constantly faced with technical breakdowns, batteries going dead, shafts breaking down, but they were replaced and improved. It is this kind of engineering debugging that our foreign customers would be faced with.

On the other hand, they have become in the last few years very sophisticated about nuclear engineering. In the last year, we have not had a discussion with any group in Europe that does not have a body of engineers, many of them educated in this country, completely familiar with the technical field, and who would know as much about what is going on here as I do. They are a sophisticated set of buyers. They know what they are facing, but they are willing to do this and interested in participating.

Representative HOSMER. I presume that this debugging cost could be included in a subsidy.

Dr. STARR. No, sir. I think this is where the American manufacturer plays a role. If we sell a plant overseas, we take responsibility for the integrity of the equipment that goes into that plant. If something fails in the plant, we expect to replace it. They are operational costs which the buyer faces. But I think that is the buyer's risk. I would leave it that way. That is where in effect he has to pay a little something to get an atomic powerplant. He has to want it. The operational risk is that instead of being on the line 80 percent of the time, which is what he plans it for, he has breakdowns which mean that he is on the line only 50 percent of the time. So he loses the income on that portion of his capital investment which he has supplied. But this, I think, is that buyer's risk. Those people that we have talked to in Europe are quite willing to face this.

Representative HOLIFIELD. Mainly because they would not be dependent upon fossil fuels.

Dr. STARR. Exactly.

Representative HOSMER. I would say that your answer indicates that you can produce an essentially debugged product?

Dr. STARR. No, not a debugged product in the sense of working 100 percent of the time as it is supposed to work. We are quite confident of coming close to this objective.

Representative HOSMER. Confident enough to assume the risk?

Dr. STARR. Exactly. We are willing to assume this risk. I think most industry is. The same holds true in this country. We would not want to build in this country a plant for a customer where we felt that he was going to get completely irresponsible operation out of this plant, because the utility itself could not afford to put this on the line in terms of getting a reliable source of power or even semi-reliable. So if we expect to stay in business for more than one sale, we would have to be pretty careful what we sell to any customer.

Representative HOSMER. There is just one other question I have to ask, and that is in connection with the part of this thing that actually is paid for by the foreign purchaser.

Dr. STARR. Yes.

Representative HOSMER. From your experience in the assessment of the market, do you feel that they have the cash to pay for these things, or is this an illusion where we come in and supply that, too?

Dr. STARR. Let me answer the question in a round about fashion, rather than directly. These countries must get power. There is just no question about this. They have expanding power needs today. If they do not get it out of atomic powerplants, they are going to have to get it out of conventional plants, so the money for conventional plant installation they must get somehow, whether it is from their own capital, borrowed capital, international loans, or loans from the United States. They have to go through this process of getting money somehow for the conventional plants, so somewhere they are going to get that portion of the money. Where they get it, I don't know. In a case like West Germany they have the money. In a case like France, that is a different problem.

Representative HOSMER. That, I think, is an important consideration when we talk about selling reactors overseas and export markets, and so forth. It is an illusion unless there is some ability to pay.

Dr. STARR. On the other hand, Mr. Hosmer, from the point of view of this country, if the French borrow from the United States so many hundreds of millions of dollars to tide them over on their national financial situation, the power industry in France is all nationalized. If they have to expand and they are going to buy plants with the money, whether directly or indirectly it comes from this country. I am sure we are helping them buy these powerplants. It is not a question of increased cost. Somewhere or other they are going to get this money.

Representative HOSMER. I am sorry. I did have one other question. That is in connection with the $2 billion overall cost of the 10-year program. Did you include in that $2 billion the cost of the AEC financing this fuel business, instead of selling it?

Dr. STARR. Yes.

Representative HOSMER. You see, there is quite a capital investment.

Dr. STARR. The $2 billion I think was the result of the private meetings we had with the Joint Committee some months ago when we discussed the broad program for technical development in the field. This was what one might call a "guestimate." Obviously at this stage a program is as much as you have money for. This is what we guessed was an adequate sum of money to give us at the end of 10 years some really economically competitive plants.

Representative HOSMER. Did it include the cost of financing this big bank of fuel?

Dr. STARR. Yes; it did, because it included these various stages of building development plants. As a matter of fact, we may end up with saving some of the money rather than going over it by going this route, because what I am suggesting is that a good portion of the cost now be paid by an outside customer, whereas previously we included completely the cost of everything being done by the AEC.

Representative HOSMER. Do you understand that my question pertains to this bank of uranium that is going to be leased out? That we put our money into it, but we get it out only when the heat comes out of it.

Dr. STARR. No; you are talking about the capital investment the country has made in the uranium stockpile.

Representative HOSMER. Yes, and that would be made in this leased out fuel.

Dr. STARR. That capital investment has only indirectly been included in calculating the fuel cycle cost. In calculating the fuel cycle cost, we have put in a price for the uranium 235 which goes into the fuel. If the price which the Government has for this is a price which includes the capital that it has already invested in getting this stuff, then the answer to your question is yes, it has been included. But what we have included is the published price for this enriched uranium. On what basis the Government has arrived at this, I don't know.

Representative HOSMER. Thank you, Mr. Chairman.

Chairman DURHAM. Dr. Starr, an important part of your plan would be the long term commitments on the fuel elements. In making long-term contracts, and with the increased improvements in the fuel elements in this country, do you think it would be to our advantage to make long-term contracts, or would it be to the advantage of the foreign government, whoever it may happen to be? I am thinking of the thing on the basis of the decrease in the cost of the fuel elements over a period of years and the improvements. Would you have an opinion on that?

Dr. STARR. Yes. I think it would be to our advantage. Let me perhaps indicate why. As far as the customer is concerned, he is getting heat at a contract price. The United States Government now has the responsibility of seeing to it that the fuel is supplied to a fabricator, taking it back and reprocessing it. I would not expect the Government to do this within its own plants indefinitely. I would hope that this would go out to American industry as rapidly as possible, and the Government would then go out on a competitive bid basis to American industry and say we need so many kinds of fuel elements, just like they buy fuel elements for the MTR.

Chairman DURHAM. Do you think the American industry would take on the job of making fuel elements and improving them?

Dr. STARR. Yes.

Chairman DURHAM. It is practically all done now by the Government.

Dr. STARR. I am presuming that the rest of American industry as I am is concerned with getting this business on a commercial basis as rapidly as possible.

Chairman DURHAM. Would you hazard a guess as to how long it would take private enterprise to get into the fuel element development and improvement?

Dr. STARR. Many of us are in this business now under Commission contract.

Chairman DURHAM. I know you are to a certain extent.

Dr. STARR. Many of them are trying to do this on their own.

Chairman DURHAM. But you are primarily now depending on the Federal Government.

Dr. STARR. Yes. One of the advantages that I think would be to the United States is that one of the difficulties in the whole fuel element fabrication and fuel reprocessing business is the lack of enough bulk business to justify plant investment. As soon as the United States Government took this over all responsibility, you would have a concentrated user and the Government could then go out and ask for bids on a fairly large basis, for chemical reprocessing and for fuel fabrication. I think you will find American industry competitively interested in doing it.

Chairman DURHAM. If I may sum up your statement, you feel that if we make a long-term contract on a cost basis on fuel elements at the present time, we do not stand much of a chance to lose money over a long period of time?

Dr. STARR. No. I agree with you. Under this program I think you would find that at the end of 10 years the Government support for this would begin to diminish rather rapidly, and at the end of 20 years it would be nonexistent.

Chairman DURHAM. And we would make money on that instead of losing money.

Dr. STARR. This is very possible, at which time you will find industry selling directly and the Government not involved at all.

Chairman DURHAM. I think on the basis of experience we have had on the fuel elements in this country we can assume that there will be further improvements in this field and a decreased cost.

Dr. STARR. Yes. As a matter of fact, I don't think there is any question about this, Mr. Durham. The drop in cost on fuel element fabrication has been very marked in the last few years.

Representative HOLIFIELD. Let us do a little A B C work on this for the record. I am sure we all understand what your plan is. I want to draw an example here.

Assuming that the present cost of a capital plant per kilowatt is $165, assuming further that we can build an atomic reactor today at a capital plant investment cost of $300 per kilowatt of capacity, this would be a differential of $135. What your company would do would be to go to a foreign buyer and say we will build you an atomic plant at $165 per kilowatt capital cost. The government would assume the difference between $300 and $165, and pay you this at home, because this would be your cost. If it ran over the $300 your plant would assume the cost?

Dr. STARR. Exactly.

Representative HOLIFIELD. If the plant ran under the $300 would you get the benefit or the Government? Remember, the Government is paying for research and development.

Dr. STARR. Mr. Holifield, I have not thought that particular part out.

Representative HOLIFIELD. This might be an arrangement where you would share.

Dr. STARR. I think this could be an arrangement by which we share.

Representative HOLIFIELD. This would give you an incentive and also the Government.

Dr. STARR. That is right.

Representative HOLIFIELD. By you furnishing the B. t. u.'s at a fixed cost which is agreeable to the foreign purchaser because he knows his costs are going up, and he also knows second and more important

to him, probably, his dependence on fossil fuels from which this would relieve him.

Dr. STARR. That is right.

Representative HOLIFIELD. Then you actually take from around his throat this monopoly position of the United States because it is no longer any concern of his as to what plutonium buy-back prices are or what fuel costs are.

Dr. STARR. That is right.

Representative HOLIFIELD. It is 8 mills per kilowatt and he does not care what it costs the United States Government.

Dr. STARR. That is right.

Representative HOLIFIELD. Then as a further incentive to the United States Government, assuming that we are selling 30-mill kilowatts for 8 mills——

Dr. STARR. You are doubling my figures, Mr. Holifield. It is more like 12 to 15 mills that we expect from a nuclear plant.

Representative HOLIFIELD. I compliment you on your enthusiasm. Let us take 15. I will go that far with you. Actually that means a 7-mill subsidy.

Dr. STARR. That is right.

Representative HOLIFIELD. If the United States Government through its laboratories or through competitive bids of other suppliers can cut that 7-mill subsidy down over the period of 10 or 20 years, we would get the advantage of it.

Dr. STARR. Exactly.

Representative HOLIFIELD. It would be a great incentive for us to go ahead with our fuel research and development program which the Commission has already said is a very important project.

Dr. STARR. That is right.

Representative HOLIFIELD. I wish I could find something wrong with it, but I can't, except it is too simple.

Chairman DURHAM. Dr. Starr, just one last question on the matter of developing an overall program. Dr. Smyth suggested putting a group of reactor experts in a room for 2 days or more and we would come up with a good program of all different types, and also on the cost of reactors. Do you think this would be a good idea?

Dr. STARR. Mr. Durham, I think this would be an excellent idea. I don't know about the 2 days. I believe it would be more like 2 weeks. But I think that actually there is usually very little difference both among the industrial people and the technical people on specific answers to specific questions. They usually get asked different questions at different times, and there is a certain amount of confusion as a result. But whenever we get into one area together, I think that we can resolve and come up with a really sound program. I would recommend this very highly. As I indicated in my testimony, we would be very happy to participate.

Chairman DURHAM. I noticed you said you offered to help us. We may have to call on you.

Dr. STARR. I think the problem when you get down to what I call tactics of working out a plan to hit these strategic objectives that these get so complicated and technical on secondary issues that it is very hard to work this out in public debate. This really does take a professional group of people to concentrate on.

Chairman DURHAM. I think you are right, Mr. Ramey?

Mr. RAMEY. In your dealings in the Italian situation, will it make much difference on whether or not we lease or sell the uranium?

Dr. STARR. Yes. Under the present framework, the sale involves a capital expenditure, the lease involves borrowing money at 4 percent, or whatever the Government sets. So from every business point of view, these people would much prefer to lease than to sell. If my plan were followed through, they would not be involved at all.

Mr. RAMEY. That is right. I meant the current situation.

Dr. STARR. That is right.

Mr. RAMEY. Would it help American manufacturers in their bids on this Senn reactor project if this Government gave assurance that it would lease rather than sell?

Dr. STARR. I think it would be a tremendous boost.

Representative HOLIFIELD. Another factor of this is that you would propose a 10-reactor plan.

Dr. STARR. Yes.

Representative HOLIFIELD. There would be a limitation upon the Government's investment under this plan.

Dr. STARR. Yes.

Representative HOLIFIELD. That could be changed later on to accelerate it if it was found to work well.

Dr. STARR. Mr. Holifield, in describing the A B C steps a moment ago, there is one point you omitted, and that is that before the Government would pay to the American manufacturer a differential support, the Government would have to agree that the plant which the American manufacturer was selling overseas was part of the kind of development program the Government wanted.

Representative HOLIFIELD. I was going to get to that. How would we determine what type the five 60-megawatt plants and the five 200-megawatt plants would be? There would be great competition among the reactor proponents as to whether it should be an organic or boiling water and so forth.

Dr. STARR. Yes. I think we determine it by competitive salesmanship on a technical basis with the Atomic Energy Commission, just as we do right now in our own programs. If I believe the Commission is ready to go ahead with another type of plant, I go in or my staff goes in and we discuss this with the Division of Reactor Development. We make our presentation, we give our arguments. This is argued back and forth on a merit basis with other proposals. Finally, a program is arrived at.

Representative HOLIFIELD. Very much as the approval has been obtained for consumers of Nebraska type and the Piqua type?

Dr. STARR. Exactly. This is what I would call technical salesmanship.

Representative HOLIFIELD. The Commission would also rely on the feasibility of the project?

Dr. STARR. That is right.

Representative HOLIFIELD. Probably the capital plant investment per kilowatt.

Dr. STARR. Yes. Whether this was a proper step in the development program.

Representative HOLIFIELD. A step in sequence.

Dr. STARR. Yes.

Representative HOLIFIELD. Of this whole plan now, let us get down to the one point, the real incentive to the Government would not be a financial incentive on the basis of return. It would be and must be the fulfillment of a program deemed to be in the national interest.

Dr. STARR. Yes, sir.

Representative HOLIFIELD. And deemed to be the economical way to go about it.

Dr. STARR. Yes, sir.

Representative HOLIFIELD. In other words, it would rely upon international prestige, the obtaining of technical information, with always in the back of our minds the possible competition from the Soviet nation in the uncommitted areas of the world.

Dr. STARR. That is right.

Representative HOLIFIELD. So while this might be branded as a giveaway, you feel that it could be justified on the basis of research and development to obtain a national goal.

Dr. STARR. I am assuming that the Joint Committee and the AEC are going to come out with a development program for the field as a whole. So from my point of view this is going to involve more expenditure. My proposals here are going to involve the same kind of expenditure but channeled through a different area—through the international area. So I would hardly call it a giveaway when we expect to do this work anyhow.

Chairman DURHAM. It is much broader, of course, than the present operation in what we are trying to do internationally.

Dr. STARR. Yes. I hope that an approach like this would grab the whole problem rather than just a piecemeal attack.

Representative HOLIFIELD. Dr. Davis' plan has been to stress a sequence of PWR reactors, and then in addition to that a number of small experimental type reactors in different areas. What you are actually proposing is a sequence in several promising types of reactors and taking advantage of the assistance that you would get up to a conventional cost basis and obtaining the international prestige that would be involved, in this type of a program which is the urgent factor, rather than building them here at home.

Dr. STARR. Congressman, I feel that any concentration on the PWR as a reactor type for use now would be very damaging to the country. The PWR is without question our most developed reactor. We have the submarine experience. We have had several installations, including the one at Shippingport. They are all fine, and they are all making progress. This is a very rapidly changing business. The enthusiasm for technical approaches changes year by year. If we were to prematurely favor any one reactor type what would really happen would be to hold up everything else, because the manufacturers and the people doing development work are going to be interested in what they can sell. If PWR becomes the reactor that the Government says we will support the sale of, we are then going to end up with all other developments held up. We may find ourselves eventually in a very poor competitive position with the United Kingdom. There is no assurance that the PWR is going to make cheaper power than the United Kingdom. The big strength of our program is that we do not have all our eggs in one basket. We have many

other reactor types. I think there is a strong feeling being generated that the boiling reactor may be superior in the long run to the PWR. We have a feeling that the organic moderated reactor may be superior to boiling reactors in a year or two. The people who push the fast breeder point out that in 5 or 10 years that may be superior to all of them. We are seeking in this country the best approaches for our long term, and so incidentally are the Europeans, although they have immediate requirements. So I think that anything that we do to keep the fluidity technically that we have is good, and anything that we do to concentrate on special types out of expediency is dangerous.

Representative HOLIFIELD. This has been the objective of the committee right along, Dr. Starr.

Dr. STARR. Yes; I realize that.

Representative HOLIFIELD. We have insisted that these different types be explored, and we do not settle on one type.

Dr. STARR. I agree.

Chairman DURHAM. Thank you very much, Dr. Starr.

Dr. STARR. Thank you.

(The following supplementary information received from Dr. Starr is hereby made a part of the record:)

SUPPLEMENTARY INFORMATION ON THE SUPPORT PROGRAM SUGGESTED BY DR. CHAUNCEY STARR, VICE PRESIDENT, NORTH AMERICAN AVIATION, INC., AND GENERAL MANAGER OF THE ATOMICS INTERNATIONAL DIVISION

SCOPE OF PROGRAM

As a reasonable basis for calculation, a program of the type suggested in the statement made by Dr. C. Starr before the Joint Committee on Atomic Energy on February 21, 1958, is assumed to involve the installation of about 5 intermediate-size (50 to 75 megawatts) and 5 full-scale (150 to 250 megawatts) nuclear powerplants in foreign countries over a 10-year period, resulting in a total nuclear capacity of 1,300 megawatts.

COST OF SUPPORTING CAPITAL INVESTMENT

Under the suggested program, initial costs would be supported to the extent of the difference in cost between a complete nuclear plant and a complete conventional plant. An estimate of the total cost of such a program involves the following assumptions:

1. The cost of a typical complete foreign conventional plant is $145 per kilowatt, with $65 per kilowatt representing the boiler and associated equipment and $80 per kilowatt all portions other than the boiler and including the turbine generator.

2. The cost of a complete nuclear plant is $300 per kilowatt now,[1] with $220 per kilowatt representing the nuclear portion and $80 per kilowatt all other portions.

3. The cost of a complete nuclear plant will decrease to $190 per kilowatt in 10 years, with $110 per kilowatt representing the nuclear portion and $80 per kilowatt all other portions.

With these assumptions, the nuclear-conventional cost difference is $155 per kilowatt now and $45 per kilowatt in 10 years, giving an average difference of $100 per kilowatt for the 10-year period.

Multiplying $100 per kilowatt by 1,300,000 kilowatts gives $130 million, the estimated cost for the 10-year period of supporting capital investment in foreign-installed demonstration plants.

[1] This is estimated to be a reasonable present cost for plants built overseas, utilizing the lower foreign manufacturing costs, and which also take advantage of prototype experience in the United States.

COST OF SUPPORTING FUEL CYCLE EXPENSES

Under the suggested program, fuel cycle expenses would be supported to the extent of the difference in cost between nuclear fuel and conventional fuel.

An estimate of the total cost of such a program involves the following assumptions:

1. The average cost of conventional fuel in foreign countries is 5 mills per kilowatt-hour over the 10-year period.

2. The complete fuel cycle cost for nuclear fuel is 7 mills per kilowatt-hour now, decreasing by about 25 percent to 5.2 mills per kilowatt-hour in 10 years. This gives a cost difference of 2 mills per kilowatt-hour now and 0.2 mill per kilowatt-hour in 10 years.

3. The load factor is equivalent to 7,000 hours per year.

4. The total of 1,300 megowatts is installed at the rate of 160 megowatts per year over the last 8 years, with none installed during the first 2 years.

Applying the declining cost difference to the increasing total number of kilowatt-hours of nuclear power gives a total fuel-support cost of about $27 million for the 10-year period, as shown in the following table:

Year	Nuclear megawatts installed	Total nuclear megawatts in operation	Total nuclear production (at 7,000 hours per year) kilowatt-hours times 10^9	Total cost of nuclear fuel, mills per kilowatt-hour	Cost difference [1]	Annual cost (dollars times $[10^6]$)
1958	0	0	0	7.0	2.0	0
1959	0	0	0	6.8	1.8	0
1960	160	160	1.12	6.6	1.6	$1.8
1961	160	320	2.24	6.4	1.4	3.1
1962	160	480	3.36	6.2	1.2	4.0
1963	160	640	4.48	6.0	1.0	4.5
1964	160	800	5.60	5.8	.8	4.5
1965	160	960	6.72	5.6	.6	4.0
1966	160	1,120	7.84	5.4	.4	3.1
1967	160	1,280	8.96	5.2	.2	1.8
Total cost						26.8

[1] Nuclear fuel cost minus conventional fuel cost.

POSSIBLE BENEFIT TO EQUIPMENT MANUFACTURERS

The suggested program would amount to about $320 million worth of business for United States reactor equipment manufacturers over the 10-year period, with about $190 million coming from foreign customers and $130 million from Government support. Part of this business would be subcontracted to foreign suppliers in the countries buying reactors.

POSSIBLE BENEFIT TO FUEL ELEMENT FABRICATORS

Assuming that fuel fabrication from UF_6 to elements costs 1.10 mills per kilowatt-hour now and will decrease by about 25 percent in 10 years, the total 10-year business to fuel fabricators from this program would amount to about $36 million, as shown in the following calculation:

Year	Total nuclear production, kilowatt-hours times 10^9	Fabrication costs, mills per kilowatt-hour	Annual volume, millions of dollars
1958	0	1.10	0
1959	0	1.07	0
1960	1.12	1.04	1.2
1961	2.24	1.01	2.3
1962	3.36	.98	3.3
1963	4.48	.95	4.2
1964	5.60	.92	5.2
1965	6.72	.89	6.0
1966	7.84	.86	6.7
1967	8.96	.83	7.4
Total business for 10-year period			36.3

POSSIBLE BENEFIT TO REPROCESSORS

Assuming that reprocessing from spent elements to UF_6 and Pu buttons costs 1.67 mills per kilowatt-hour now and will decrease by about 25 percent in 10 years, the total 10-year business to fuel reprocessors from this program would amount to about $54 million, as shown in the following calculation:

Year	Total nuclear production Kwh x 10^9	Reprocessing costs mills per kilowatt-hour	Annual volume millions of dollars
1958	0	1.67	0
1959	0	1.62	0
1960	1.12	1.57	1.8
1961	2.24	1.52	3.4
1962	3.36	1.47	4.9
1963	4.48	1.42	6.4
1964	5.60	1.37	7.7
1965	6.72	1.32	8.9
1966	7.84	1.27	10.0
1967	8.96	1.22	11.0

Total business for 10 year period = $54.1 million.

Chairman DURHAM. The next witness is Mr. John Linsenmeyer, executive vice president of operations, American Radiator & Standard Sanitary Corp.

We are glad to have you here.

STATEMENT OF JOHN C. LINSENMEYER, EXECUTIVE VICE PRESIDENT, OPERATIONS, AMERICAN RADIATOR & STANDARD SANITARY CORP.

Mr. LINSENMEYER. Thank you, Mr. Chairman. I am glad to be here. I hope that what I have to present here, Mr. Durham, will not be a sort of anticlimax to Dr. Starr's very masterful presentation. Generally, it agrees with his broad strategy concept, although some of the points I advance in tactics, as he puts it, may differ somewhat.

Chairman DURHAM. You may proceed.

Mr. LINSENMEYER. I am John C. Linsenmeyer, executive vicce president, operations, of American Radiator & Standard Sanitary Corp. It is a pleasure to respond to your invitation to present our comments and observations on the development, growth, and state of the atomic-energy industry.

Before going into detail, however, I would like to touch generally on the interest of American-Standard in the atomic-energy field.

Our corporation has for many years been a leading manufacturer of industrial equipment and, as such, we supply a significant amount of equipment each year to the power industry and to a number of atomic-energy projects. When the Government started its atoms for peace program in 1954, we examined our role in this field and determined that American-Standard could contribute significantly to it.

A little over 2 years ago, we formed an atomic-energy division of our corporation which is now located in Mountain View, Calif. It is the objective of this division to design and construct atomic reactors, to manufacture special atomic equipment, and to assist the other industrial product divisions of our corporation to produce the highly specialized atomic equipment that are normal extensions of their

product lines (that is, condensers, heat exchangers, mechanical draft fans, boiler feed control, and fly-ash collectors).

We manufacture, for example, nuclear heat exchangers, special nuclear valves, a full line of nuclear process instrumentation, fluid drives, and special air- and gas-handling equipment. We are also constructing at our Mountain View laboratories a nuclear-training reactor designed and being offered for student training at colleges and universities. In addition, our atomic-energy division staff has designed a new type of boiling water reactor which, through simplification of basic design, we feel will go a long way in lowering power costs, and reducing the capital cost of nuclear power stations.

Over the past 2 years our activities in California have grown and our present staff now numbers approximately 140. We have recently constructed a new engineering laboratory with a specialized manufacturing facility devoted exclusively to atomic energy work.

American-Standard has built up its facilities and product designs in the atomic energy industry entirely with its own funds. Therefore, our interest in this industry is a real one, and one in which we hope and feel there should be much progress. However, over the past few years while this new industry has been, so to speak, learning to walk, there have developed conditions about this industry that we feel should be reviewed, and it is on this matter that I would like to comment.

It is my view that for any industry to remain healthy it must have clear-cut economic incentives. However, since the atomic industry is still in its infancy and owes its birth to the Government development programs, it has not yet been possible to define in normal fashion just what the economics of this business are. With such clarification, it is difficult for management on its part to evaluate just how much to invest in it and in what areas to make its investment. The problems that affect this industry most particularly are:

1. The most attractive and only substantial commercial market for nuclear energy is for electric power generation; however, on the basis of present-day costs, it does not appear that it will be commercially competitive in the United States for the next 10 to 15 years.

2. The application of nuclear energy is of long-range importance to our economy, and its use may have a vital influence on United States world technical leadership. Because of these facts, the Government has offered a program of partial financial support which has been in effect for several years. However, this program also requires utilities and equipment manufacturers to assume serious risks and to provide substantial subsidies which cannot be justified on the basis of its near-term commercial attractiveness, or future profit.

3. There are numerous other problems which slow down progress in our industry. They include the lack of normal patent incentives, restrictive and costly security procedures, unusually high costs in engineering with a high uncertainty as to future cost recovery, high capital cost ratios, liability problems in export sales, Government-controlled materials, and the potential long-term obsolescence of fission systems through the development of thermonuclear power. Also, because of the very newness of the art, changes during construction constitute a heavy addition to costs.

With the problems that beset this industry, management is bound to reconsider continuing to make such substantial investments of their

stockholders' money. Quite clearly there is a certain glamor associated with atomic energy, and it seems to me that the real long-range incentive is the potential world market for generation of electrical power from atomic energy. However, the problem we, and apparently other similar industries face, in these times of stringent profit squeeze, is whether we can afford continual investment of funds for such long-term results.

Even now economics abroad justify such major programs as EURATOM. The problem we face is how the United States can maintain its pioneering leadership both here and abroad with the competition we know to exist in England and in Russia. It would be a tragedy indeed to lose our leadership in this field which is so important to our national interest because of a program not sufficiently emphasized or defined to permit continued competitive progress. I firmly believe that our position can be improved and our leadership clearly maintained through a clear-cut definition of United States policy which will lead to adoption of a program to encourage the investment of the necessary private capital to bring this about.

Let me offer my thoughts on how our present program might be improved.

1. In the development of nuclear-power reactors, we believe that the Government must continually reappraise its power demonstration programs by competent groups in order that comparison may be made between competing systems. Industry cannot obtain without such assistance adequate information regarding the prospects of economic power. We feel that the Government should, therefore, publish on an annual basis an official technical and economic survey of reactor types under construction and under development. The Government should also publish its conclusions as to the development areas of greatest promise and should support and plan the development of the most promising systems and the improvement of these systems in a clearly defined, long-range program of reactor development.

2. The Government should reach a definite policy as to the reasons for the construction of small-scale plants. At present, small plants are constructed for a variety of reasons, and the information obtainable from such plants is far from adequate. The Government should adopt a firm policy of building small pilot-plant reactors whenever the technology of a reactor type is not sufficiently well known or understood to permit the construction of full-scale plants. Basic criteria of these small plants is that they should operate at the same power density as large-scale plants, so that the results are applicable to major power-generating units. These small plants should be located at Government installations or abroad under agreements of technical cooperation.

With Shippingport PWR station and other nuclear-electric generating units in operation, in addition to our spectacular ship-propulsion plants, the problem is no longer one of demonstrating the practicability of nuclear power, but rather of refinement and improvement to the point where a kilowatt from an atomic reactor can be produced as cheaply as a kilowatt from a fossil-fuel plant. This sort of refinement can come only from a series or family of plants, built in sequence and using the lessons learned from the construction and operation of older

plants. That is how the electric-generation industry of the United States has advanced to its present position.

We are so much more efficient than any other nation in producing electric power that this very fact, of itself, is one of the principal obstacles to atomic progress. According to report, power produced by the Calder Hall reactor in England approximately matches the cost of fossil-fuel power there. But a reproduction of Calder Hall in this country would be an economic white elephant after being put into operation.

Representative HOLIFIELD. In case this last sentence in your statement is a widely publicized and general misrepresentation of this committee's position, I just interrupt you at this time to say that this committee has never asked for a reproduction of a Calder Hall plant

Mr. LINSENMEYER. I realize that, Mr. Holifield.

in this country or anywhere.

Representative HOLIFIELD. We have asked that the principle used there be developed in a 50,000-kilowatt plant, but we have always in our reports and in our questioning of witnesses said that we wanted them to start with the knowledge that we know we have on that point and go forward with a very much improved type.

Mr. LINSENMEYER. That is exactly what Dr. Starr was advocating: Leave no channel unexplored.

Representative HOLIFIELD. We have never advocated the replica of an existing plant. We realize that this technology is in a position of transition. We have always said that while we may use the same principle, we want to improve on it.

Mr. LINSENMEYER. There is some popular misunderstanding on the point that I think should be clarified.

Representative HOLIFIELD. Deliberately planned and placed, I might say, in the pages of the Congressional Record and in the advertisements of utility companies and in the statements of Commission members. That is, upon each occasion I get a chance, I try to correct the impression.

Chairman DURHAM. I think the record of hearings is very plain on that point and I am glad Mr. Holifield brought it out because, as he said, we have never advocated at any time a duplication of the exact type of Calder Hall. We feel that is in the field of reactor development just like the PWR and the organic and every one of them.

All we asked for was improvement and to see whether the development of such a reactor is economical.

Representative HOLIFIELD. If a program is put to use to build another Shippingport plant, this committee would be the first to turn it down or any other plant that has been built.

Mr. LINSENMEYER. As indeed you should. We have to build on the past and on the lessons of the past.

3. Increased emphasis should be given to the location of large-scale plants in the most economic areas. Such plants should be constructed only when the pilot plant reactor mentioned above has been operated. Large-scale plants constructed to gain the necessary full-scale operating information should in the main be constructed abroad where they are needed and where they will be economically sound when put into operation. I might say more nearly economically sound because, as Dr. Starr has pointed out, initially they all will

require some sort of subsidy. The United States credit agencies should assist in the financing of research and development in this country and the subsequent construction of the plants in friendly nations.

4. The Government should adopt a bolder policy in the investigation of reactors for space and process heat. There would be substantial markets as progress is made in these fields. Although the economics have not yet been demonstrated, the promise for economic operation is evidently greater here than it is in the electric power field. Economic and operating experience can and should be obtained through operating full-scale space and process steam plants at Government facilities. Though individually smaller in size when compared with their power counterparts, these space and process heat reactors have a great potential market. Practical operating experience with these reactors should enable us to understand their potential much more fully with a comparatively lower expenditure.

5. There must be a clarification of the liability insurance situation in foreign countries. The lack of actuarial experience and the unknowns in the area of liability produce a most discouraging obstruction for the private contractor. Considerable has been done in this field, but liability potential is one of the most frightening aspects of the art.

Conclusions: Briefly, we have suggested emphasis on the following:

1. Encouragement of a family or series of small power reactor installations in the United States, in each of the more promising design concepts.

2. Publication by the Government of all principles and conclusions arrived at in these exploratory and development areas.

3. Increased emphasis on large or full-scale plants in friendly areas outside the United States, where economics of operation are more favorable.

4. Encouragement of investigation and development of reactors for space or process heat in United States and elsewhere, as opposed to electric-power generation.

5. Clarification of the liability insurance situation outside the United States.

6. Increased governmental support to competent research and manufacturing enterprises who have demonstrated their own permanent dedication to the nuclear art by substantial private investment.

I might say I was listening to Dr. Starr's very masterful exposition and the only thing in his very complete coverage of the subject that struck me was the fact that it seemed to me to neglect to some extent a wider dissemination of the art in the United States.

Representative HOLIFIELD. You mean information on the art.

Mr. LINSENMEYER. No; I mean in the operating level in utilities and even in private generating and space heat process plants.

If we are going to maintain the traditional American leadership and so on—I know that Dr. Starr does not intend this—this nuclear art cannot be left the property of the scientists. It has to get down to the engineering and plant operating level because it is only by this operation and this familiar art that real progress comes in efficiency, if I may say so.

You cannot brain-trust your way as our public utilities have in some cases to 5- or 5½- mill power on the bus bar by planning alone.

A lot of that comes from operation.

Representative HOLIFIELD. A lot of it comes from manufacturing development as contradistinct from utility operation.

Mr. LINSENMEYER. That is right. The trouble with this concept of relatively few tremendous plants is that the manufacturers of components and everything else lose, in a sense, continuity of operation. You do not get everyone. You are lucky to get 1 out of 10. It is years between the time you do something on one and on another one.

This concept I am proposing here of small power generating plants, it is my impression from talking to public utility operators, in order for prestige, stockholder satisfaction and everything else, they would risk their money in many cases on a 15- or 20-megawatt plant where the operating penalties of a 200-watt plant, bearing on them down through the years, appalls the board of directors. Not so much the capital outlay, but this question of selling 10-mill power that costs them 30 mills, is horrible to a financial man. It is that continual drain.

Representative HOLIFIELD. It is horrible to us, too.

Mr. LINSENMEYER. It is horrible to me.

Representative HOLIFIELD. Every time I look at the cost of that Shippingport reactor operation in terms of the cost per kilowatt, I shudder.

Mr. LINSENMEYER. But still it is a magnificent achievement.

Representative HOLIFIELD. Of course, we realize that this is the first.

Mr. LINSENMEYER. It broke the ice.

Representative HOLIFIELD. We know the reason why, but still you cannot help but get a shock when you look at the cost of these kilowatts compared with our fossil fuel costs.

Mr. LINSENMEYER. That is right.

Chairman DURHAM. The complaint seems to be that the information does not flow freely between industry and the Government.

Mr. LINSENMEYER. There is much that can be done on that, Mr. Durham. There is information disseminated, but it is rarely—from my experience, and please do not classify me with a specialist like Dr. Starr because I am a mechanical engineer and decidedly not an atomic expert—the information I see is spotty in its concept. You rarely see a tabulation of 10 reactor concepts all tabulated and worked out to an answer as a regular and orderly sequence.

Maybe it is a little early to expect that sort of thing, but I think our efforts on small plants and others should be directed toward that end, almost to a textbook concept of what we know.

Chairman DURHAM. The engineers and reactor development people have to work very closely in these improvements and in the dissemination of information?

Mr. LINSENMEYER. Yes. Just as they do in the conventional power-plant development. All the people involved have an association, and surprising as it may seem, they pool an awful lot of what they know.

I cannot speak too highly of the operating end of our public utilities. I do not know whether people realize what a stupendous thing these people have done on the economical production of power. It is largely by pooling their experiences and everything else. It has pushed this thing to a point where, as I think I mentioned in here, it of itself is one of our major obstructions to atomic power. We are competing with the best people in the world.

Chairman DURHAM. In fairness to the development, it never was in the same position as the start of atomic energy, which was a completely socialized and Government monopolized industry for years.

From that, we must get to the point where we coordinate the thing as we did in the utilities, where they brought the cost of power down and down all the time.

I can see your point. It is very important, I think.

Mr. LINSENMEYER. I do not know whether you gentlemen know it, but in the operating levels of public utilities, there is a tremendous degree of pride in what they do. If Consolidated Edison goes up to 4,200 pounds of pressure, then Public Service of New Jersey's next one will be 4,300 pounds. This has pushed it up to where is is. Whether this extends up to the board of directors or financial people, I do not know. They look for the profits, I think.

These operating men, the vice presidents who control this thing, they are very proud.

Chairman DURHAM. They did not have to come running to the Federal Government to get advice on everything they did.

Mr. LINSENMEYER. That is right.

Chairman DURHAM. On page 3, you mention the boiling water reactor. Would you explain in a little more detail the unique system?

Mr. LINSENMEYER. Yes. We use the water itself as a substitute for the conventional control rods in a pressurized water reactor or the other kind, by varying the level of the water surrounding the fuel tubes, and we can control the output of the reactor.

The big advantage that we can see in it is that it reduces the pressure vessel cost. Much of the cost of the boiling water reactor is the seal around the control rods. The control rods themselves are enormously expensive. The fact that they must enter the fuel elements on a very tight limit of clearance forces us to relatively expensive fuel element cladding, which again must be built to accurate limits.

We believe what we have will very, very substantially lower the cost of the reactor proper, which is, after all, the main target of this whole thing. Once you have the steam out of it, everything else more or less falls into line.

Chairman DURHAM. That is where your saving comes.

Mr. LINSENMEYER. That is right.

Representative HOLIFIELD. That is just ordinary water?

Mr. LINSENMEYER. Yes.

Representative HOLIFIELD. You use it up as a neutron slower?

Mr. LINSENMEYER. Yes.

Representative HOLIFIELD. And the level of the water opposite the fuel elements becomes the control?

Mr. LINSENMEYER. Yes.

Representative HOLIFIELD. What is the disadvantage of that type of operation?

Mr. LINSENMEYER. I would say that the main disadvantage is the uncertainties we have or the lack of a specific demonstration of a prototype.

Representative HOLIFIELD. Dr. Zinn conducted the first excursion in this?

Mr. LINSENMEYER. Yes.

Representative HOLIFIELD. A deliberate excursion?

Mr. LINSENMEYER. If you are going to ask technical questions on this, I have the director of our place here and I would much prefer you ask him.

Chairman DURHAM. He may answer the question if you wish.

Mr. FRANK PARKER (American Radiator and Standard Sanitary Corp.) My name is Frank Parker, and I am the director of the atomic energy division of our company.

Dr. Zinn did not carry a similar experiment to this.

Representative HOLIFIELD. His was a boiling water experiment.

Mr. PARKER. He conducted an experiment where he deliberately imposed an excursion.

Representative HOLIFIELD. That was to test the pump?

Mr. PARKER. This was to test what would happen in the event of an excursion. In this instance the water is raised and lowered in the reactor to control the output of the reactor, much in the same way that the control rods operate.

I think Mr. Linsenmeyer has explained the basic advantages of this system, permitting a core that is not a Swiss watch, so to speak.

Representative HOLIFIELD. Do you think the technology in that field is ready now to build a 40,000- or 50,000-kilowatt reactor?

Mr. PARKER. We are proposing a 20,000-kilowatt reactor of this type.

Representative HOLIFIELD. In your proposal of these smaller reactors, you do that with a recognition that you voluntarily assume a higher kilowatt cost?

Mr. LINSENMEYER. Capital cost and perhaps a slightly higher operating cost; yes.

Representative HOLIFIELD. You think in the long run it is the economical way to make the development steps?

Mr. LINSENMEYER. The advantages are that it is less of a total investment and you cannot help but look at that. They can probably be constructed more quickly.

Our great need in this is to get some sons and grandsons of what we already have, in my opinion, without waiting too long. In some cases, I believe these things could almost overlap.

When one reaches a certain stage, a lot of the knowledge will enable us to start another. In many cases, Mr. Holifield, I could conceive of a utility taking an existing fossil fuel powdered coal plant, maybe of 20,000- or 25,000-kilovolt-ampere capacity, leaving the boilers stand there, and putting a nuclear steam generator in and feeding steam into their existing turbine. That would certainly reduce the capital cost greatly. It would reduce the unfavorable comparison between the power cost of the nuclear plant and the whole fossil fuel plant, because these smaller plants are usually 30 or 35 years old and they are inefficient. They are saturated steam turbines or have little superheat.

We feel with our variable moderator reactor feeding the steam directly into the turbine, only nominal shielding is required, which could be put in an existing plant.

Another advantage of such a process would be—I am getting really down to the grassroots on this thing—is one that is not so glamorous. The fact of the case is that you could avoid duplication of pumps and equipment.

Although this may seem like a sign of weakness, if there is a failure in one component of the reactor system, you can fire the boilers up again and run it.

Representative HOLIFIELD. This is the general thought of the Piqua people because they are interested in using the process steam. They are planning to use their conventional installation in connection with the new organic moderated reactor which the North American people are planning to build. So they are actually putting into practice just what you are talking about.

Mr. LINSENMEYER. I really did not know that. I am glad to hear it. It is just one more phase of the business with which I am entirely in accord with Dr. Starr and his enterprise.

I think we have to get a lot of plants running. We have to get people over the terror that this new art seems to inspire even among engineers. They shy away. Even from my limited contact with it, it is not so terrifying. It requires care the same as any steam plant in the handling of the equipment.

Chairman DURHAM. Getting away from the subject of reactors, I believe you people are in the field of radiation work, too.

Mr. PARKER. Yes, sir; that is correct.

Mr. LINSENMEYER. Are you talking about domestic heating and that sort of thing?

Chairman DURHAM. I thought you were in the field of radiation work, such as foods and things of that sort.

Mr. LINSENMEYER. We have been involved.

Mr. PARKER. We were selected as a subcontractor to Kaiser engineers.

Representative HOLIFIELD. The Army project?

Mr. PARKER. Yes, sir.

Representative PRICE. Could you give us some idea of your experience?

Mr. PARKER. The work was never funded to my knowledge. There was a small research and development contract issued to Kaiser to investigate the corrosion aspects of the indium sulfate solution which circulated through the food-preservation reactor core. This work was conducted jointly between Kaiser, ourselves, and Food Machinery and Chemical.

The work was stopped, I believe, in December, and more recently the Department of Defense has made the decision to go ahead with a cobalt 60 source.

I might add this was not the result of any technical information that developed under the contract.

Chairman DURHAM. Of course, we have had this question of corrosion coming up here so much, and that is why I asked the question.

Mr. PARKER. We had very good results with the experiments that we were working on. There would be no real problem of using the indium sulfate solution as the circulating solution.

Representative PRICE. Are you still in the program?

Mr. PARKER. No. Although we have never been actually terminated under the contract, there has been issued a stop order.

Representative PRICE. To Kaiser?

Mr. PARKER. Yes, and we as the subcontractor to Kaiser.

Representative VAN ZANDT. Is it not true in the meantime that the Department of Defense and the AEC are preparing to ask for bids that will be distributed among the various concerns, such as Kaiser, Curtiss-Wright, and others?

Mr. PARKER. It is my understanding, sir, that they are going to go out for quotations on another cobalt 60 source for the same purpose.

Representative PRICE. You made a statement that it was not the result of any technical problem?

Mr. PARKER. That is correct.

Representative PRICE. What was the reason for it, as you know?

Mr. PARKER. This was a policy decision, as near as I can determine, within the Department of Defense.

Mr. RAMEY. Of not using a reactor, but to have a station near cobalt 60 source for the radiation?

Mr. PARKER. That is right.

It is my understanding that the funds were never released for this purpose by the Bureau of the Budget.

Representative PRICE. Have you gone into it deep enough to have any opinion as to which appeared to be the quickest and better approach?

Mr. PARKER. I think quite naturally we favor the cobalt 60 approach. We see no technical problems that would prevent it being produced on time and within our estimated cost.

Representative VAN ZANDT. And at a much smaller cost. That is, the difference between the cost of cobalt 60 and a reactor?

Mr. PARKER. This is an argument that is subject to much discussion.

We believe, on the basis of time, however, that the reactor could be completed and operated and you would have a more flexible facility.

Representative PRICE. You said the cobalt 60. Did you not mean the reactor?

Mr. PARKER. I meant the reactor.

Representative PRICE. You were not in on the cobalt 60?

Mr. PARKER. We were not in the cobalt 60.

Representative JENKINS. Mr. Chairman, Kaiser has several plants. Which of his plants are you dealing with?

Mr. PARKER. Our contract is with Kaiser Engineers in Oakland, Calif.

Representative VAN ZANDT. To clarify this point, is it not true that the Department of Defense made a decision that they would go the cobalt 60 way in preference to the reactor way?

Mr. PARKER. This is my understanding.

Representative VAN ZANDT. At the present time, they are preparing to ask for bids from concerns on the project that involves cobalt 60.

Mr. PARKER. I understand this to be correct, too.

Representative PRICE. Were you far enough advanced in your study to give an opinion here as to the differences in the approach and the economics involved in the two approaches?

Mr. PARKER. We have prepared, and I do not have it with me, sir, an analysis of the comparative costs between the two systems.

Representative PRICE. Would you mind submitting that for the record?

Mr. PARKER. I will be glad to submit it to the committee.

I think that the results are somewhat preliminary, and I would hesitate to submit it for the record.

Representative PRICE. You may submit it to the committee and it will not be included in any published record.

Mr. PARKER. Yes, sir.

Chairman DURHAM. Are there any further questions from the committee?

Mr. RAMEY. Have you investigated this cobalt 60 question?

You mentioned your interest in the process steam. There have been proposals of having a small reactor that could make process steam and also cobalt 60 and sell the cobalt 60 for food irradiation purposes and use the process steam in a chemical plant or something like that.

Do you think that has possibilities so that a demonstration plant might be built?

Mr. PARKER. We are aware that this scheme has been proposed. We have not tried to examine the economics of it. I believe that this could be done, however. But the economics would have to stand on their own feet.

Chairman DURHAM. Are there any further questions?

If not, Mr. Linsenmeyer, we appreciate your statement very much.

Mr. LINSENMEYER. Thank you very much, gentlemen.

Chairman DURHAM. The next witness is Mr. Nagey, director of Glenn Martin.

STATEMENT OF TIBOR F. NAGEY, GENERAL MANAGER, NUCLEAR DIVISION, THE MARTIN CO., BALTIMORE, MD.

Mr. NAGEY. Thank you, Mr. Chairman.

Chairman DURHAM. You may proceed with your statement.

Mr. NAGEY. Thank you, sir.

Gentlemen, I am pleased to appear. My remarks concern themselves with a very limited aspect of this very complex problem we are handling.

During the past several years, the nuclear power industry has been slowly retrenching as a result of soaring costs and the growing realization that there is no early prospect of operating a nuclear plant at a profit. There have been many in industry who have found that the cost of development is out of proportion to the possible return on investment and, as a consequence, they have elected to drop out of the nuclear power business.

Contributing also to the decline has been the fact that others have found that, in order to continue their programs, it has become necessary to cut back or eliminate some phases of their planned development and to rely on research programs brought about by the Atomic Energy Commission.

It is becoming increasingly apparent that in order to develop a competitive nuclear powerplant, just engineering and reengineering existing plants may not be the answer. It begins to appear that the most realistic course to a truly competitive plant lies not in engineering development, but in basic invention resulting from research.

The presumption here is that there can be no doubt that early development of nuclear power is desirable, and if this country is to have a capable nuclear industry at the earliest possible time, then

it appears that the research and development and construction programs necessary must be paid for by the Government to an even larger extent than is currently the case.

The Government must provide firm direction and goals to assure efficient and effective application of available Government resources, and as a consequence, the Government program, which can be the only major program, must serve as a guide to the lesser programs that private industry is capable of financing and carrying forward.

If the foregoing is a sound premise upon which to project the development of nuclear power, then what vehicle appears to present the most promise for such development?

In my opinion, a major military program for the development of nuclear energy is the most plausible solution. Performance in the military field by the Atomic Energy Commission and the Department of Defense, in conjunction with industry, has been outstanding in this country when a strong program has been undertaken. In the field of atomic energy, the most notable example is the naval reactor program, with its consequent commercial applications. Outside the nuclear field, aircraft and electronic development have demonstrated rapid advancement, with resulting surges in invention, as a result of their being closely identified with military programs.

It is my opinion that nuclear development can benefit in a similar fashion. To me it is almost a truism that military requirements are more urgent, more demanding of our skills, and quite often beyond the state of the current art.

I suggest that a review of the present reactor program from a military applications standpoint discloses that the military is not interested in just one reactor type, but is interested in reactors of many different types.

Furthermore, it appears to me that military programs will also call for several reactors of the same type. If this is true, then the development and operation of several reactors of a particular type would answer an important question regarding the degree of efficiency to be achieved, and would also permit a more thorough comparison to be made between reactors of different types.

To me, there appear to be many places in the military where reactors could be utilized. The significant difference lies in the fact that nuclear power does not require economic justification to the same degree as in a civilian program, but can be justified on the basis of logistics. Logistics in turn ultimately result in economic justification. Thus, military reactor programs, if broadened and accelerated, would, in my opinion, undoubtedly contribute to accelerated invention, research, and development, a course of events which would ultimately materially add to our future civilian needs.

Lest I create the impression that I am advocating a nuclear power development program exclusively military in character, let me state that I recognize that there exist a limited number of reactor types that cannot be forced to wear a military hat. However, I see nothing to prevent the development of these types being carried out as preplanned by the Atomic Energy Commission as a part of their ancillary civilian program.

The course of action I have been advocating is founded in large measure in my belief that the budget figures recently made available

to the public show that the civilian program and the naval program are scheduled to be the leaders in further development of atomic energy. Obviously, this is based on the funds to be expended. All other military programs exclusive of the aircraft program, which I consider a unique application of nuclear power, formed but a very small percentage of the moneys to be expended.

I believe a commercial program can be a natural byproduct of a successful military program. I further believe that the wisest and most productive course for this country to pursue is to initiate many military programs and apply the technical fallout to commercial fields. Such a program would strengthen our country in two ways: It would enhance our military strength, and at the same time advance the cause of commercial nuclear development.

Chairman DURHAM. Thank you very much, Mr. Nagey.

You did not go in detail into the application of your thought as to the military. As I recall, I believe we have authorized all the reactors that have been requested by the Defense Department, for the Navy, the Army, and the Air Force. I do not recall one that they requested that we have not authorized.

I believe that is correct.

Mr. NAGY. I believe you are correct in that.

My intention here is to indicate that of the bases that are to be built and are being built within this country, as well as the DEW line, these would be useful and successful applications of nuclear power at a very early stage.

Chairman DURHAM. That was the point on which we based our opinion when we developed the one at Belvoir. I do not believe there has ever been a proposal to build any sizable reactors at the installations in this country to use power.

Mr. NAGEY. I do not believe this proposal has ever been made up to this time.

Chairman DURHAM. I do not believe I would be for such a program.

Mr. NAGEY. You would not be?

Chairman DURHAM. I would not.

If you are thinking along that line, I am just speaking frankly my own opinion, because I think that would get the peaceful uses of the atom entirely in the hands of the military, which I do not want to see. They have a habit of stamping everything secret. We are having a bad enough time now with the AEC.

If you are thinking in those terms, I would have to disagree with you.

Mr. NAGEY. Sir, my only reason for thinking in these terms, and you might find it palatable from this standpoint, is that the nuclear field is so entirely new that you can turn around and find several different reactors that all appear to be very satisfactory on paper. One of the best places to exploit these very new ideas, in my opinion, would be for ourselves.

Chairman DURHAM. You admit it would be a subsidy to the military. What is the difference in subsidizing the civilian as contrasted to the military.

Mr. NAGEY. I would have to defer answering that question. I do not know the answer.

Chairman DURHAM. I do not see any difference. It is the taxpayers' money.

Representative HOLIFIELD. I think you have a misapplication here of the situation.

Of course, we recognize the tremendous value of the development of the *Nautilus* engine to the PWR. When we get these new eight reactors for this aircraft carrier, which is being built now, this will undoubtedly give us a boost in the field of propulsion.

But I think the one fallacy which is in your argument, and you state at the top of page 3:

> The significance lies in the fact that nuclear power does not require economic justification to the same degree as it does in a civilian program, but can be justified on the basis of logistics.

We justified the *Nautilus* engine without regard to the cost of the kilowatts on the basis of logistics, but this does not solve the problem, which is a very important problem, and our goal, the economic production of power in a competitive field in a large power station.

We have supported the military program 100 percent.

I know in the building of a truck, for instance, the Army will build a truck and they do not care whether they get 3 miles to the gallon or 10 miles a gallon on the truck, as long as it will go over a certain type of terrain. But the man who is hauling goods on a commercial truckline is very much concerned with the economics of it.

I think your general logic is refuted by your own statement there.

Chairman DURHAM. I assume he was speaking about the larger types of reactors because that is what we are struggling with primarily. We have applied everything to the military that seems to be feasible and what they can use, based on their need.

Mr. NAGEY. Sir, possibly if I restate the argument in another form, it will clarify the matter.

I feel that, in order to now expand very rapidly on the existing knowledge that we now have and try to carry this into the commercial fields, we will be spending a great deal of development money on ideas that are already old.

The most useful application of the money, in my opinion, would be on these newer ideas that are yet untried and certainly would not find utilities anxious to put them on their lines, small or in large size. There appears, then, to be a desire for developing these extremely advanced type reactors and there appears to be but two feasible places—within the AEC itself, or within the military.

I choose the military for this development application because of their urgent requirement.

Representative PRICE. Where would those requirements be?

Mr. NAGEY. As I indicated, one of the immediate ones, and the most apparent, would be for airfields; the DEW line.

Representative PRICE. The DEW line I can see. Airfields, where?

Mr. NAGEY. A good example might be the airfield in the upper tip of Maine.

Representative PRICE. You mean outside the continental limits of the United States?

Mr. NAGEY. There are areas within the continental limits of the United States as well as outside.

Representative PRICE. We developed what was supposed to have been a package reactor for the military, with the thought in mind that

it might be usable in projects like the DEW line. Nothing has happened since then.

We have developed the reactor. They have it over at Belvoir. Our justification for it at the time was that it was to be available as a sort of package deal that they could set up within a short time in a remote area where military installations were located.

We had in mind at the time the DEW line and other very remote and inaccessible places. But nothing further has developed along that line.

Mr. NAGEY. The comment I have there is that the development at Belvoir is an exceptionally fine one and has demonstrated many points and it is serving a further basic purpose of being a source of training.

Representative PRICE. That was not the basic purpose. The basic purpose was to prove the feasibility of a package reactor that could be quickly utilized in remote areas by the military.

Mr. NAGEY. Which has already been demonstrated by being in operation.

Representative PRICE. But so far, it has ended with the demonstration. They have not made use of it.

Representative HOLIFIELD. They cannot make use of it because it became such a large plant that you cannot wrap it up in a package. It is so uneconomical that by the time you transport a reactor of that size to the DEW line, you do not know how you would get it up there.

Mr. NAGEY. We in our company have spent our own funds for the past 3 years developing just this sort of thing, a packageable, transportable reactor.

Representative HOLIFIELD. I hope it is smaller and more transportable than this one.

Mr. NAGEY. The entire facility is composed in 7 packages, which are approximate dimensions, 9 by 9 by 30 feet, which fit into a C–124 type aircraft.

Representative PRICE. What about the concrete frame for the housing?

Mr. NAGEY. The housing is a part of the packages.

Representative PRICE. It is a concrete blockhouse?

Mr. NAGEY. No, sir. They are preformed packages which both serve as a housing for the reactor as well as its transportation crate.

Representative PRICE. How long do you estimate it would take to install such a facility anywhere on the DEW line?

Mr. NAGEY. Sixty days. We have a proposal of this sort in at the present time.

Representative PRICE. That is one-third of the minimum time that has been given to us before. They were making some presentations to us before and they estimated within a period of 6 months they could do it. You say it could be done in 60 days?

Mr. NAGEY. The plant is essentially built in the factory and the umbilical connections are made in the field.

Representative PRICE. It could be done in 60 days if you had all the material on the site to start with?

Mr. NAGEY. No, sir; this is not what I intended.

It is done in 60 days by doing all your welding, your X-raying of your weld, and so forth, within the factory at home before it is shipped to the site.

Representative PRICE. You could not get it up there in 60 days. You would not be able to fly all the parts of this reactor such as demonstrated at Fort Belvoir?

Mr. NAGEY. I should like to take the privilege of sending our technical information on this to the committee for their consideration.

The variation between what we are suggesting and Belvoir is great indeed. The reactor, incidentally, is not a paper reactor at this point. We successfully operated it at zero power at the plant this December.

Representative HOLIFIELD. You have already built this?

Mr. NAGEY. We have built the core of the reactor. We have not bothered to make the electricity. It would be a total output of 1.3 megawatts.

Representative HOLIFIELD. How does that compare with Belvoir?

Mr. NAGEY. Belvoir, I believe, is 2,000 kilowatts.

Representative HOLIFIELD. Yours would be slightly smaller?

Mr. NAGEY. That is right.

Representative HOLIFIELD. Just a little over half as large in output?

Mr. NAGEY. That is right.

Representative HOLIFIELD. How about the gross bulk of it? If you are going to put it in seven planes, it would be a lot smaller than Belvoir?

Mr. NAGEY. Yes. This offers no criticism to the Belvoir concept.

Representative HOLIFIELD. I understand that.

Mr. NAGEY. The concept of our plant from the onset was to be able to fly it in existing aircraft.

Representative PRICE. You think you can do it?

Mr. NAGEY. We sincerely believe we can. In fact, we believe it so sincerely that we have made a firm price proposal to the Government.

Chairman DURHAM. Do you think that will contribute much to the technology of advanced reactors?

Mr. NAGEY. I hesitate to answer the question, sir.

However, in the development of this reactor, we were forced to build as small a reactor as is possible. Consequently, with our own money again, we have developed a tubular fuel element based on the powder metallurgy technology which allowed a smaller longer-lived core. I believe this one facet has been a contribution to the reactor technology.

Chairman DURHAM. You believe that the application of it is relevant?

Mr. NAGEY. We believe it is.

Representative HOLIFIELD. It would be very interesting to have the information presented to the committee in full form.

Chairman DURHAM. I would like to see it.

Representative PRICE. What is the estimated cost of it?

Mr. NAGEY. The estimated cost would be $3 million, f. o. b., stateside.

Mr. RAMEY. That is about the same as the Belvoir?

Mr. NAGEY. I believe so.

Representative PRICE. Does that include the core?

Mr. NAGEY. This does not include the fuel for the core. It includes the fabrication of the core.

Representative PRICE. I think it is an interesting idea and the committee would certainly like to have more detail on it. We have been

a little disappointed in reference to the Fort Belvoir as being a portable package reactor because it is obvious that it is not.

Mr. NAGEY. I believe that this general principle of what we have tried to accomplish at the Martin Co. can be applied in many other areas.

Chairman DURHAM. It sounds very interesting.

If you have made an improvement on the Belvoir, maybe that is one way to charge off this research and development.

Representative PRICE. We are not criticizing the Belvoir thing. It was just a fact that we had to prove it out.

Chairman DURHAM. No, we just had to begin.

Mr. NAGEY. As I said, our only advantage over the Belvoir reactor is that our first attempt was to put it into packages to fit into an airplane, which they never had as a goal.

Representative HOLIFIELD. Which is very important.

Chairman DURHAM. As far as operation is concerned, it is a very fine plant, but it turned out to be a large animal instead of a small one.

Mr. NAGEY. A great deal of our technology in this development came from that plant.

Chairman DURHAM. I assume so.

Respresentative HOSMER. Is this a PWR plant?

Mr. NAGEY. Yes, sir.

Chairman DURHAM. Are there any further questions?

If not; thank you very much, Mr. Nagey.

The committee is adjourned until 2 o'clock, and we will meet in room 1334 in the New House Office Building.

(Thereupon, at 12:33 p. m., the committee recessed, to reconvene at 2 p. m., same day, in room 1334, New House Office Building.)

AFTERNOON SESSION

(The committee reconvened at 2 p. m., pursuant to recess, in room 1334, New House Office Building.)

Representative HOLIFIELD. The committee will be in order. The first witness this afternoon is Mr. Samuel B. Morris, chairman of the atomic energy committee of the American Public Power Association. I understand that Mr. James L. Grahl, director of the Atomic Energy Service, is going to take Mr. Morris' place today. Mr. Grahl, will you please take the witness stand.

STATEMENT OF JAMES L. GRAHL, DIRECTOR, ATOMIC ENERGY SERVICE, AMERICAN PUBLIC POWER ASSOCIATION, WASHINGTON, D. C.

Mr. GRAHL. Thank you. Mr. Chairman, Mr. Morris asked me to convey his regrets at not being able to be here today. He is in California and could not get away.

Representative HOLIFIELD. We are glad to hear from you, Mr. Grahl. You may proceed.

Mr. GRAHL. Thank you. My name is James L. Grahl, director of the Atomic Energy Service and assistant general manager of the American Public Power Association.

The American Public Power Association, in whose behalf I am testifying, is a national trade organization representing more than 800 local publicly owned electric utility systems in 40 States, Alaska, and Puerto Rico. Headquarters of the association is at 1025 Connecticut Avenue, NW., Washington. D. C.

Our association has had a long-standing interest in an effective program for the development of economically practical atomic powerplants. Member systems of the association have endeavored to participate in the power demonstration reactor program of the Atomic Energy Commission, and the Consumers Public Power District of Nebraska now has a contract with the AEC for a 75,000-kilowatt project. The city of Piqua, Ohio, is continuing to negotiate with the Commission on a contract for an atomic power demonstration project of 12,500 kilowatts.

However, our association has believed for some years that while these projects certainly should go ahead, and that the privately owned utilities should proceed with the projects they have proposed, the utility sponsored projects do not constitute an adequate program for the expeditious, effective development of atomic power. We have believed that the extraordinarily high costs of full-scale developmental atomic power projects, and the unusual technical problems associated with them, require that these non-Federal projects be supplemented by some Federal atomic powerplants if the United States development program is to have a firm base and a positive sense of direction. The experiences of the past year with the various atomic power projects which have been proposed have confirmed these beliefs.

The slippage in the United States program is illustrated by the fact that whereas in 1955 the Atomic Energy Commission predicted that, by the end of 1960, there would be 1,160,000 kilowatts of nuclear generating capacity in the United States, exclusive of reactor experiments, it now is evident that we will be lucky to have as much as 543,000 kilowatts in operation by the end of 1960. At the same time, as this committee knows, the cost estimates of all projects have climbed very sharply.

The rather discouraging experiences to date with the projects proposed in response to the first two invitations issued by the Atomic Energy Commission under its demonstration program seem to have had a shrinking effect on the size of the projects proposed in response to its third and most recent invitation. Whereas all of the 4 projects proposed by the private utilities in 1955 were of 100,000 kilowatts or larger, 3 or the 4 current proposals under the third round are for plants of less than 100,000 kilowatts and the fourth has recently been revised from a 150,000 kilowatt project to one of 70,000 to 150,000 kilowatts.

This trend toward smaller plants is in direct contrast to the trend in Britain. There the trend is strongly toward progressively larger power stations and reactors, with resulting decreases in unit costs. The 4 commercial plants under construction in Britain, of 2 reactors each, range from 275,000 to 500,000 kilowatts and it is reported that a station of 800,000 kilowatts is under consideration.

As this committee knows, the experiences of the past year have resulted in a wave of pessimism in industry over the future of the power

reactor business and a number of firms reportedly have curtailed their activities in the power reactor field.

Paradoxically, the year 1957 was also the period in which a record number of small experimental power reactors were completed and the world's largest wholly civilian atomic power reactor went into operation in the United States. In other words, while our technical development program was making substantial progress, our equally essential full-scale reactor program was losing speed and certainty.

It is instructive to note, I think, that the greatest strides forward are being made in the sector of the program which is publicly financed and directed, while the difficulties and delays are most serious in the part of the development program which has been largely privately financed and directed. Five of the six small power reactors completed in 1957 and the Shippingport project were the products of Federal initiative, Federal leadership and, with minor exceptions, public financing. These were the fruits of public enterprise. Of course, private industry played a major and indispensable role in all of these projects as contractors to the Government, but the point is that the financial responsibility, the initiative, the direction, and the drive came from the Federal Government.

The projects which were completed in 1957, with the exception of the General Electric 5,000-kilowatt plant, were products of the AEC reactor laboratories. Their successful completion and operation testify to the competence of these publicly financed organizations. They doubtless comprise the most extensive reactor laboratory complex in the world.

In short, the United States seems to have done well in the development of power reactor technology up through the construction of pilot model plants. At this crucial point, however, the AEC suddenly stops short and relies entirely on the utilities for the full-scale projects which are essential to make further advances in the technology. The Commission offers financial assistance but the initiation of a project, the choice of reactor type and size, and the rate of progress on the projects are up to the utilities.

The Atomic Energy Commission, with its large reactor laboratories, is uniquely equipped to make these decisions and to press ahead boldly in the face of technical problems and unpredictable costs. Although been, in our opinion, a serious mistake for the Atomic Energy Commission to abandon its rightful responsibilities and to relinquish leadership to the utility industry, which has neither the economic incentives, the technical competence, nor the financial resources to carry the burdens of leadership effectively. The construction of full-scale projects as a consequence has proceeded in a halting and uncertain fashion.

It is evident that the achievement of economically practical nuclear powerplants will not be easy. The power reactor experts agree that a series of full-scale plants of each reactor type must be built and operated, at a loss, in order to prove out the economic value of any given reactor concept. We do not advocate that the Federal Government undertake the entire job, but we are convinced that this is too big a job, and the decisions involved are too fateful for this country, for it to be left primarily to the utility industry.

We accordingly advocate a well planned and vigorously prosecuted Federal program for the construction and operation of some full-

scale developmental atomic powerplants, free from involvement in the problems of individual utility corporations. This would prove a firm base for the rapid exploitation of one or more reactor types and allow the utility projects to proceed at their own pace free of the burden of primary responsibility for establishing and maintaining international leadership.

As in previous years, the American Public Power Association supports the enactment of legislation along the lines of S. 3000, the bill introduced by Senator Albert Gore and Senator Mike Monroney and of H. R. 2154, introduced by Congressman Holifield. We do not regard this as public power legislation. We support it because it would establish a firm program for building some of the necessary full-scale plants and should enable the AEC to push the development of at least one type of power reactor to the point of economic practicality. Obviously this should be the minimum objective.

In view of the growing agreement, outside the Commission, that the United States program lacks defined objectives and a clear policy, we recommend that provisions be added to the Gore-Monroney-Holifield legislation which would—

1. Assign by law unequivocal, primary responsibility to the Atomic Energy Commission for the early development of economically practical atomic power. Admiral Rickover has pointed out that, in a large scientific undertaking—

> the essential is the assignment of responsibility * * * unless you can point your finger at the man who is responsible when something goes wrong, then you have never had responsibility. Unless you have that type of responsibility, the thing will not get done well.

2. Establish by law two objectives for the AEC atomic power program: (*a*) the earliest possible development of at least one type of atomic powerplant which will be economically competitive in foreign countries and in an appreciable portion of the United States; and (*b*) the longer term development of one or more types of plant for the production of really low-cost electric power, competitive with power from conventional thermal stations in most of the United States.

3. Require that each plant authorized by the Gore-Monroney-Holifield legislation be of a type and size, to be determined by AEC, that will contribute directly to achieving one of the stated objectives.

4. Recognize the invaluable resource represented by the Government reactor development laboratories and require, by law, that for each of the projects authorized by the Gore-Monroney-Holifield bill, the Commission shall assign to one of these laboratories the primary responsibility for technical leadership and direction. AEC and the laboratories would be expected to utilize, under contract, the private equipment and reactor engineering industry to the maximum feasible extent.

5. Because of their importance to the smaller utilities, industry and underdeveloped foreign countries, authorize and direct the Commission to develop and build some atomic powerplants suited for economically practical operation in the 10,000- to 40,000-kilowatt-size range.

It remains our belief that if the major program objectives are defined by Congress, if responsibility is firmly fixed on the Commission to achieve these objectives, and if AEC is given the authority and

funds to build the necessary developmental plants, a much needed impetus will be given to the United States atomic power effort. We believe this added program should be one of Federal atomic powerplants. The United States already has a "partnership" program, and it is difficult to see how an enlargement of it would help much with the basic problems which beset the United States program. There have been proposals for larger Federal subsidies for private projects but spending more money for more "partnership" projects will not remedy the lack of strong leadership, the lack of firm objectives and the lack of a sense of urgency which presently characterize the United States atomic power development program.

Mr. Chairman, I have some brief remarks I would like to add to my prepared statement, if this is agreeable to you, sir.

Representative HOLIFIELD. You may proceed.

Mr. GRAHL. On previous occasions we have testified before this committee in favor of extending the period of time during which the Atomic Energy Commission can require the cross-licensing of privately owned patents when this is in the public interest. Under the present act the entire section on patent cross-licensing, section 153, becomes of no effect with respect to any patent applied for after September 1, 1959.

Our association believed in 1954 that the 1959 expiration date would prove to be premature. The rate of atomic power development in the United States has been slower than many expected in 1954, when the present act was adopted, and it is now clear that the possibility of important inventions and patents in the fission power field will be substantial after September 1959.

In addition, I believe that the patent cross-licensing provisions in the Atomic Energy Act would apply also to developments in controlled thermonuclear research, a technology which is hardly under way.

We believe, therefore, that it is very important to retain in the law AEC's authority to compel cross-licensing of patents with reasonable compensation to the patent owner for much longer than the next 18 months in order to prevent the development of any patent monopolies or restrictive patent licensing practices.

We recommend that section 153 (h) be amended to extend the expiration date by at least 10 years to September 1969, or alternatively to eliminate the expiration date entirely and make the authority indefinite in duration.

Thank you very much for the privilege of appearing before this committee.

Representative HOLIFIELD. Are there any question? Mr. Price?

Representative PRICE. No questions.

Representative HOLIFIELD. Mr. Hosmer?

Representative HOSMER. I have none.

Representative HOLIFIELD. I am glad to see you bring this patent problem out in the open. We had a very short interchange the other evening at one of our meetings in which Mr. Diamond, counsel for the Atomic Energy Commission, testified that in 4 years' time the AEC had not declared one patent as of the public interest, and therefore claimed the patent rights in that field. This is an astonishing piece of testimony to me. I cannot understand how in 4 years of technical development, with the intent of Congress outlined as it is in

section 153, that the Atomic Energy Commission could not find one patent which it thought to be in the public interest to protect all of the industry of the United States from an exclusive patenting arrangement.

I have asked the staff to make certain inquiries of the Patent Office, and also certain inquiries to find out what the British Government has done during this last 4 years to protect the taxpayers of Great Britain against people filing claims in areas of technological progress which has been accomplished with taxpayers' money.

I hope before the hearings are over that we will have some additional information on this point to bring into the record. It is not the purpose of the Chair to question the advisability of the American patent system when it functions under its own steam. But I think every Member of Congress would be dilatory in their discharge of their oath to protect the people of the United States against exploitation if they failed to protect in this vital field the technology which has cost the American taxpayers $15 billion.

Mr. GRAHL. Yes, sir. This expression of views on our part, I should make clear, certainly does not reflect any desire to see any punitive action taken against American industry. The protection which the compulsory cross-licensing offers is basically a protection to American industry against exploitation by one or a few companies. We are interested in this because our people are naturally interested in the ultimate cost of atomic powerplants.

In this connection I would add that in a speech of a year or two ago, the then Attorney General, Herbert Brownell, pointed out that the principal problems in the area of antitrust would arise in the field of licensing and patents. In the field of patents, as you know, a patent monopoly is a legal monopoly. It is beyond the reach of the antitrust laws. That is why the Congress put this reserve power in the law in the first place.

Representative HOLIFIELD. Are you aware of any patents that have been filed by private industry in this field during the past 4 years? Has your organization made any kind of study of this?

Mr. GRAHL. No, sir, we have not.

Representative HOLIFIELD. Have you heard of agreements of convenience between manufacturers of equipment in the interchange of what is ordinarily called trade practices or trade secrets.

Mr. GRAHL. I have not heard of that specific practice. I have been told by people in industry that at least some firms have decided that rather than file patents, they would rely on trade secrecy to protect whatever developments they may have made in these years. This is encouraged by the fact that the compulsory cross-licensing provision will expire within a short period of time. This is simply an oral statement that was made to me, and I certainly could not prove it.

Representative HOLIFIELD. Are there any questions, Mr. Ramey?

Mr. RAMEY. On page 5, item 4, your point on using the Government reactor development laboratories to provide the technical leadership and direction for particular reactor projects, would you include the Bettis Laboratory which is operated by Westinghouse, which happens to be an industrial outfit, as one of these laboratories?

Mr. GRAHL. Yes. I do not know what the title is that one can apply to this whole reactor laboratory complex but we would include

Bettis Field, and I think there are several other industrial laboratories.

Mr. RAMEY. Argonne?

Mr. GRAHL. Yes, Argonne, Oak Ridge, possibly Brookhaven, if their capability is such, Los Alamos, perhaps, and I believe there is a laboratory complex operated by North American which would be part of this organization.

Mr. RAMEY. It would be more like Bettis.

Mr. GRAHL. Yes.

Mr. RAMEY. There is one problem involved in this. About the only pattern we have so far in this direction is the Bettis Laboratory building the Shippingport reactor. But actually the technical direction has been provided by the Naval Reactors Branch under Admiral Rickover operating out of Washington. The outfit that is operating the laboratory is an industrial outfit. Do you think a place like Argonne, which is operated by a university with groups of universities participating, or Oak Ridge, which is operated normally by an industrial outfit, but operates pretty much like an academic laboratory in a lot of ways, their competence is in pilot plant work and small scale work and gadgeteering and there might be some question whether they could assume technical direction for a large scale reactor project. Possibly the pattern of having a couple of more Rickovers around directing projects out of the central office or in the field might be more appropriate to the kind of effort that would be involved.

Mr. GRAHL. Our principal point here, without trying to determine what the precise administrative arrangement ought to be, is that it seems to us that there is no question but that the bulk of the know-how in this country, and certainly the bulk of the research and development equipment, is in the AEC-financed laboratories, but that these people are cut off at the pilot model stage. Argonne and Oak Ridge, for example, have men who have ideas about larger plants that they would like to see built. Not only the ideas but to the extent possible the technical competence in the national laboratories, it seems to us, should be utilized to the fullest. We don't say that this should be the permanent pattern. We would expect industry to increasingly become competent in this field. But during the developmental period if you have this research capability, it seems to us you should make use of it. When we were at Argonne, for example, a suggestion was made by the engineer in charge of the EBWR of a type of arrangement for a 100,000-kilowatt plant which I have not seen suggested by anyone else, but which he would very much like to see tried.

Mr. RAMEY. A pattern that has developed in the atomic energy work is something a little more of what you would call a collaborative effort of your national laboratory in a project that it had the idea on and worked up a pilot plant job, and then you would go to an industrial contractor on a cost basis—for example, the Hanford reactors were built by industrial contractors on a cost basis but designed by Argonne.

Mr. GRAHL. The same way with Savannah River.

Mr. RAMEY. The same way with Savannah River with Dupont building them.

Mr. GRAHL. This would seem to me to be a feasible arrangement.

Mr. RAMEY. This is a pattern that the national laboratories are used to following and permits the bringing in the kind of industrial competence that they need on large scale projects.

Mr. GRAHL. This would seem a reasonable arrangement to continue. By keeping the national laboratories in a key role, there is the opportunity to make these full scale projects an integral part of a total development program instead of having them pop up here and there as the result of somewhat uncoordinated ideas by groups that are otherwise not working with each other.

Representative HOLIFIELD. In other words, your thought is that there should be a definite program established.

Mr. GRAHL. Yes, sir.

Representative HOLIFIELD. And we should follow that program rather than leaving the Government to chance and to the interest of one individual.

Mr. GRAHL. Yes, sir.

Representative HOSMER. Assuming that the Government gets a program established, what difference would it make whether it is executed by a private or public laboratory so long as they are both competent?

Mr. GRAHL. I don't think that it makes any difference from that standpoint. We don't have any preference between public ownership or private ownership of laboratories.

Representative HOSMER. You made your recommendation here because you felt that would help not the technical development, but the definition of the program, is that right?

Mr. GRAHL. We make this recommendation because at the moment the principal strength in the country is located in publicly financed laboratories. This is no criticism of private industry. It is a historical development, as you well know.

Representative HOSMER. I had in mind that the man from American Standard testified this morning about a reactor that they were especially hot on. If they decided to have a full scale one built, wouldn't it be a good idea to turn it over to his organization as it would be to a Government laboratory?

Mr. GRAHL. I don't like to make invidious comparisons.

Representative HOSMER. Assuming that he is technically competent to do it?

Mr. GRAHL. I know a couple of people in that company as it happens, for whom I have a very high regard. One of them is a very good friend of mine. I think with possibly 1 or 2 exceptions you cannot find a private corporation in the country today which can match the national laboratories when it comes to the development and design job involved in designing any kind of a new reactor.

Representative HOSMER. Then your recommendation is based on your opinion of the excellence of the national laboratories.

Mr. GRAHL. That is right. I would expect that as the years pass the situation will change and perhaps become reversed.

Representative HOSMER. Would the same be true with respect to your recommendation that these large scale reactors be developed for the purpose of achieving an excellence in that field? If some other means was found to do it, other than the Federal Government building these reactors, would you be just as pleased to have that other

means, too, or do you have some particular reason for your public building?

Mr. GRAHL. The way we look at it is this. We have a program right now in the United States for atomic power development, and at the full scale end of the program, without exception, I guess, is what is called the partnership program. We have endorsed this program and some of our members have taken part in it. But we have also said from the beginning that this is not a firm enough program or a sufficiently coordinated program to do what needs to be done, and that in our opinion if the United States really wants to move ahead most rapidly, the most rapid way to do it is to take your best organizations and to get Federal financing, because of the costs involved, and go ahead and build some projects.

Representative HOSMER. I understand that. Apparently the objective you want to achieve is to establish and maintain international leadership by the United States.

Mr. GRAHL. This is one of them.

Representative HOSMER. If there are other means of accomplishing the thing just as soon as and in as great proportion, would you recommend those means be adopted rather than the one you specifically suggest?

For instance, Dr. Starr this morning presented a somewhat different approach to the problem than you have. If his approach would get us there as fast and as fully or maybe faster, would you see any objection to adopting it instead of the one you mentioned?

Mr. GRAHL. No. If somebody comes up with a proposal which in our opinion is just as good as this Federal approach, we are not wedded to a Federal approach just because it is Federal. Here I perhaps speak personally rather than for the association, because after all, Dr. Starr only testified this morning. It seems to me that any approach which involves cash subsidies to the industry—and by the atomic industry I include the utilities of all types and manufacturers—carries with it the danger that you will never arrive at an unsubsidized state.

Representative HOSMER. His proposal was to subsidize the foreign purchasers.

Mr. GRAHL. The money was to go to American firms. The incentive to reduce costs to an economic level, it seems to me, gets dampened if the manufacturers get used to the fact that somebody is going to pick up the difference. It seems to me inevitable that the incentives to reduce costs are just a little less strong than they are otherwise.

Representative HOSMER. The United States is going to pick up the tab under your plan, is it not?

Mr. GRAHL. That is right, but it is on a more clean-cut basis, it seems to us at least, and it is a more finite program. In other words, you decide to build X reactors and build them, and the industry is not established on a subsidized basis in the same way that it is through assistance on fuel costs or capital costs or some other element of cost which is made available across the board.

What I should add, as I mentioned in the beginning, is that our association has never said we are opposed to Government assistance to atomic power projects, because we have not opposed the demonstration program per se. For the same reason I would not say that if

someone comes up with some kind of larger subsidy program we would automatically be opposed to it. But I do think that the Federal approach is simpler and more clear-cut, and it seems to me it is arousing a lot of worry on the part of the private utility industry that is not justified. I don't know what they are so nervous about. They say it will bring about the socialization of industry, but this is just not so.

Representative HOSMER. Thank you.

Representative HOLIFIELD. You were kind enough, Mr. Grahl, to refer to Senate bill 3000 and H. R. 2154, which was introduced by the Chair, and you said you do not regard this as public power legislation.

I think it might be well for the record to explore your position on that, because that has been branded, or rather those types of bills have been branded as public power legislation by the privately owned utilities and a great deal of the press, and has been given a very odious connotation. When I introduced that bill, I certainly did not regard it as public power legislation. I think there are three positions in this utility field, and one is the person who believes that the Government should own all power and produce all power, the second that private utilities should own and produce all power, and then there is a third position which recognizes that the Congress of the United States has throught legislation established certain rules which permit people who wish to have public power in their community to organize municipal or cooperative power districts and operate these districts for their own benefit, and has also sponsored certain types of Federal legislation which permit the rates of power in interstate commerce to be established on an equitable basis through certain regulatory powers, and also to recognize the right of a State to set its utility regulations on both public and private power entities within their borders. I am thinking particularly of the State of Nebraska, which has what amounts to a State monopoly in at least part of their power production and distribution.

The intent of this legislation was not to disturb the status quo. The intent of the legislation was to develop as quickly as possible the new field of fission-produced electric kilowatts on an economical basis as quickly as possible, and then make that new development available to the complete spectrum of power in the United States. In other words, the city of Los Angeles, which has a municipal power system, if they wanted to, could install their own atomic reactor. By the same token, the Southern California Edison Co., which is a private utility, could do the same. Both of these utility people serve different parts of my district. They could both have access to this new technology which was developed for the common good of all in the United States. This I am sure was the purpose and intent of this legislation. I am glad to see you say that you do not regard it as public power legislation. You do not advocate, do you, a program which would be specifically for the public power people?

Mr. GRAHL. No, sir. The philosophy that you just expressed with respect to your bill reflects our philosophy and this is why we support the legislation. It seemed to us it was a simple and straightforward compromise, if you will, that avoided disturbing the present situation in the power industry, because the plants to be built would be located at AEC installations, and the power used by AEC. This would keep the AEC out of the power-marketing business, and it

seemed to us exclude it from the public-private power controversy, although it has not.

It seemed to us originally that it ought to. Beyond this, if there is a question about it, I am sure that if the bill were passed and the decision made to locate a plant, let us say, at Portsmouth, Ohio, which is served by a private power company, OVEC, and presumably there would be one at Oak Ridge where the greatest amount of power is consumed by AEC, which would release power back to the TVA as the one at Portsmouth would release power to the American Gas & Electric Co., we would see no objection to this.

Representative HOLIFIELD. Let us explore that for just a minute. If a 100,000-kilowatt plant was built at Oak Ridge—I believe the present consumption is more than a million kilowatts.

Mr. GRAHL. It is well over a million kilowatts at Oak Ridge. I have forgotten the figure.

Representative HOLIFIELD. If a 100,000-kilowatt plant was built there on the Government property, this would release 100,000 kilowatts ostensibly back to TVA, and TVA could distribute that within its present network of distribution.

Mr. GRAHL. Yes, sir.

Representative HOLIFIELD. If the same thing happened at Paducah, either the Shawnee plant or the EEI plant or both of them together would receive turnback which they could distribute to their private customers in their area.

Mr. GRAHL. Yes.

Representative HOLIFIELD. And the same thing would happen with OVEC at Portsmouth.

Mr. GRAHL. Yes.

Representative HOLIFIELD. It so happens that the private utilities in that area are furnishing Government under their contract electricity at a very low rate.

Mr. GRAHL. Yes, they are.

Representative HOLIFIELD. If 100,000 kilowatts were turned back to the OVEC people, could they not market that at a much higher price to their regular customers than they are now getting from the Government?

Mr. GRAHL. I would think so.

Representative HOLIFIELD. As a matter of fact, you know that their regular customers do not have a 3.5 rate.

Mr. GRAHL. It is slightly under 4 mills. I don't recall the exact rate.

Representative HOLIFIELD. You know the private consumers do not have that type of rate.

Mr. GRAHL. No, sir.

Representative HOLIFIELD. As a matter of fact, they might be able to sell the same electricity to a financial advantage; is that not true?

Mr. GRAHL. It would probably be to their economic advantage, yes. I assume it would be.

Representative HOLIFIELD. They are now benefiting from a 25-year contract which in effect amortizes their plant for them at the 3.6 rate, or whatever they are paying.

Mr. GRAHL. Yes. It was because of a Government contract that they were allowed to finance by 95 percent bond financing and only

5 percent equity financing. So that this is the cheapest capacity they have on their system, I suspect.

Representative HOLIFIELD. As a matter of fact, the Government through this very unusual contract with both EEI and OVEC made it possible for the private utilities to acquire plants worth hundreds of millions of dollars on an amortized rate out of the receipts of power which they sold to the Government; is that not true?

Mr. GRAHL. Yes.

Representative HOLIFIELD. This might be called a subsidy, too, might it not?

Mr. GRAHL. It might.

Representative HOLIFIELD. Your main objective as far as the American Public Power Association is concerned is to see economic power reactors developed that will produce electricity economically so that in the future if our organization wants to buy one of these plants it will have access to it just the same as the private utilities would have access. That is your main interest, is it not?

Mr. GRAHL. Yes, this is our main interest. We would also be concerned that it be done in such a way that it does not distort the whole utility industry. The reason in our opinion that this is so important is because while atomic power is a gleam in the eye economically now, 30 or 40 years from now atomic energy may well be one of our principal sources of power. If this segment of the industry gets all fouled up with subsidies, it will affect the entire industry.

Representative HOLIFIELD. You have different sections of public power in your association. You have municipal and State-owned cooperatives, and you have the Federal system. They are not members of your system?

Mr. GRAHL. Our association includes no Federal systems as members. They are all local publicly owned systems. This means that it is comprised mostly of municipals in terms of numbers, and public utility districts and State-owned agencies.

Representative HOLIFIELD. You do not have any Federal representation in the association?

Mr. GRAHL. No, sir.

Representative HOLIFIELD. How about the cooperatives?

Mr. GRAHL. A few rural cooperatives belong to our association, but the National Electric Cooperative Association—I believe you will find most of them belong to that.

Representative HOLIFIELD. In the case of any of these rural co-ops that are financed by Federal loans in the event that they wish to buy an atomic plant, where do they go to get the money?

Mr. GRAHL. At the present time?

Representative HOLIFIELD. Yes.

Mr. GRAHL. They can only go to the Atomic Energy Commission, because the Rural Electrification Administration does not regard nuclear powerplants as a good business investment at the moment.

Representative HOLIFIELD. In other words, they cannot borrow money today from the REA to buy an atomic plant, can they?

Mr. GRAHL. No, sir. They can borrow the money for the turbo generator, but they cannot borrow a nickel for the reactor system from REA.

Representative HOLIFIELD. Assuming that the Government did build these plants, the federally financed cooperatives could not go to the REA and borrow the money to buy one, could they?

Mr. GRAHL. Not at the present time. The REA has said that if and when atomic power becomes economic, then they would loan money for a nuclear powerplant in the same way that they do for a coal-fired plant.

Representative HOLIFIELD. When it would get down to the point of economic justification.

Mr. GRAHL. Yes, sir.

Representative HOLIFIELD. Let us go outside of your organization for TVA, if TVA wanted to buy an atomic reactor to beef up its system, what procedure would they have to go throught?

Mr. GRAHL. I will have to give you simply my opinion. I am afraid I am not an expert on the details of the TVA Act to be sufficiently sure. I would assume that first they would have to determine how they were going to finance it. As you know, there is a TVA self-financing bill under consideration in the Congress at the present time.

Representative HOLIFIELD. But that has not been passed.

Mr. GRAHL. Lacking passage of that, there are two sources of funds. They are either appropriated funds or their own earnings. Their own earnings would hardly be sufficient, I would think, to finance a nuclear powerplant of any size. They have not had any appropriated funds for generating capacity, I believe, since 1953, and there is no prospect of their getting any.

Representative HOLIFIELD. In other words, in case they wanted to buy an atomic reactor to beef up their system, they would have to come to Congress for an appropriation, would they not?

Mr. GRAHL. Yes.

Representative HOLIFIELD. Just the same as a steam plant.

Mr. GRAHL. Yes.

Representative HOLIFIELD. So at that time Congress would have the opportunity just as they have in the Johnsonville steam plant several times as to whether they would appropriate the money for it or not.

Mr. GRAHL. Yes, that is correct.

Representative HOLIFIELD. In the case of their reserve earnings, can they spend that without congressional authorization for beefing up their system?

Mr. GRAHL. I am not sure of the precise answer to that, Mr. Chairman. I am embarrassed that I am not.

Representative HOLIFIELD. I will share your embarrassment, but my opinion is that they must obtain congressional authority for the expenditure of earnings for capital plant investment. If it were not so, they would, long ago, have built the Johnsonville steam plant with their own earnings, because every year they turn over earnings to the Congress.

Mr. GRAHL. That is true, but they are required by law, as you know, to pay back the capital investment in the power facilities down there over a period of time.

Representative HOLIFIELD. I understand that, but they are ahead of their payments. They have paid in surplus earnings over their obligatory annual payments.

Mr. GRAHL. Yes, sir.

Representative HOLIFIELD. If they were free to use these surplus payments, in my opinion, they might have used them for the Johnsonville steam plant.

Mr. GRAHL. I think the principal obstacle to doing that is that their earnings are not large enough to finance a large steam plant. They can finance a single unit and a large unit at an existing steam plant out of earnings.

Representative HOLIFIELD. They cannot exercise that without congressional release of those surplus earnings, in my opinion. I am subject to check on that, but I think I am right on that.

Are there any further questions? If not, thank you, Mr. Grahl.

Mr. GRAHL. Thank you.

Representative HOLIFIELD. Our next witness is Mr. James G. Patton, president of the National Farmers Union.

Mr. MCDONALD. I am representing Mr. Patton.

Representative HOLIFIELD. Will you please give your name and position to the reporter?

STATEMENT OF ANGUS McDONALD, COORDINATOR, DIVISION OF LEGISLATIVE SERVICES, NATIONAL FARMERS UNION

Mr. MCDONALD. My name is Angus McDonald. I am coordinator, division of legislative services, National Farmers Union, Washington, D. C. I will proceed now, Mr. Chairman, to read my summary statement.

Officials and members of our organization have been interested in the atomic energy program from its inception. We communicated our interest to Members of Congress when the McMahon Act was passed in 1956, and in subsequent years. In 1954, when the act was revised, we worked closely with Senator Ed Johnson and other Members of the Congress in an attempt to safeguard for all the people the benefits of atomic energy utilized for peaceful purposes.

Specifically we were interested in the widest possible use of radioactive isotopes which would advance the science of agriculture and advance the treatment of cancer and other diseases. We were also interested in advancing technology which would facilitate and make more economical the generation of electric power by means of atomic fission. Our approach to this whole problem has been that atomic energy is a part of the public domain and that since the American people have an investment in atomic energy development in the amount of $16 billion or more, that they are entitled to its benefits and to the formulation of the basic policies which govern the development and the disposition of atomic energy and all its uses.

Farmers Union in the form of resolutions and in other ways has repeatedly urged Congress to enact legislation which will insure the widest possible distribution of atomic energy benefits including electric power. We have urged legislation which would guarantee maintenance of preference clauses relating to energy produced by Federal atomic programs and further safeguards which would prevent atomic power from becoming a private monopoly beyond the reach of Federal control or regulation.

In formulating our resolutions we were conscious of the fact that the development of atomic power was a task so vast in a field so un-

explored that it would require all possible technical and financial assistance from the Federal Government, from industry, and from the private electric power utilities. We urged that not only plans be made and carried out for the establishment of a number of small-scale and a number of large-scale reactors by the Federal Government but that arrangements be entered into with the utilities that they could go full steam ahead in the development of atomic energy.

We furthermore recommended that a liberal program in regard to subsidies be carried out. We also urged that the nonprofit groups, including the municipalities and the rural electric cooperatives be assisted in every way possible. We had high hopes for the development of an atomic energy electric power program which would be participated in by the Federal Government, by industry and by the private electric utilities, by municipalities, and by electric power cooperatives.

It is apparent, at the present time, that the atomic power program of the United States has bogged down. The policies and the program of the Atomic Energy Commission have been on the whole a dismal failure. Several manufacturing firms, having entered the power reactor field with high hopes, are now, according to our information, disbanding their reactor engineering staffs. Industry, under the policies of the AEC, has been given more or less a free rein and every encouragement possible. Industry assured the Congress and the country that it could do the job. The president of the Pennsylvania Power & Light Co. told this committee that in regard to large power reactor construction, the Government of the United States should not intervene.

According to the American Public Power Association results have been disappointing and I quote from an editorial published by that Association in its Newsletter on October 29, 1957:

"During the past year project completion dates have slipped and estimated costs have risen alarmingly, for one reason or another. The Yankee Atomic plant, originally proposed for completion in "late 1957" at an estimated cost of $33 million, is now scheduled for 1960 or 1961, at an estimated cost of over $50 million. The Power Reactor Development Co. project is now promised for completion in 1960 or 1961 instead of the original date of "late 1958." The plant proposed by Consumers Public Power District was originally planned for completion in 1959; the latest estimate is 1962 and costs have climbed from $25.1 million to $40.6 million.

Consolidated Edison has reported a cost increase from $55 million to $90 million. Site construction is underway but core design is incomplete and plant completion by 1960 would be a remarkable achievement indeed. Commonwealth Edison still sticks to 1960 as the date for its plant of 180,000 kilowatts, the largest proposed, but reported changes in the core design of the Commonwealth Edison plant.

The AEC partnership program to develop small nuclear powerplants—a program announced about 2 years ago—is a shambles. Of the 5 proposals by municipal and rural co-op systems given prolonged consideration by AEC, only 2 remain. The Holyoke (Mass.) Ford Instrument proposal was abruptly thrown out by the Commission after 11 months of negotiation, with no adequate explanation by AEC to the sponsors or the public. (Despite the fact that AEC dismissed the Holyoke-Ford proposal as technically premature, Britain expects to have a reactor experiment of the same general type in operation by 1960.) The proposals of the Wolverine (Mich.) rural co-op and the Elk River (Minn.) cooperative are both indefinitely suspended due to recent massive increases in the manufacturers' cost estimates. Most significant, both manufacturers rejected the AEC requirement that prices be on a firm, maximum ceiling basis. The uncertainties of reactor development, the manufacturers concluded, require that the Government pay whatever it costs to build these early plants.

The two projects left in the small power-reactor program are those proposed by Piqua, Ohio, and by the Chugach co-op and Nuclear Development Corp. combination. The Piqua project is still in negotiation with the Commission. AEC has signed a contract with NDA for research work on the second project and the question of a construction contract will not be considered until later.

In 1955, AEC estimated that by the end of 1960 there would be 1,160,000 kilowatts of nuclear generating capacity in operation in the United States, exclusive of reactor experiments. At the present time, the only full-scale power reactor for which completion is certain is the Government-built PWR of 60,000 to 100,000 kilowatts at Shippingport, Pa. There now is little assurance that any other powerplant, aside from reactor experiments, will be in operation by the end of 1960.

The recent annual report of the Atomic Industrial Forum said that "although industry in the past has been willing to operate at a loss or with very low profit margins as far as atomic energy work is concerned, there is a serious question of how long this practice can be continued."

Experts in the field of atomic energy seem to agree that there is no clear-cut Government program in regard to atomic energy development, that private industry alone cannot carry the load in development and construction of reactors, and that Congress should make available sufficient funds to build reactors large enough to develop the necessary technical information and that there must be succeeding generations of a given type. Typical of scientific opinion were the announced results of a closed seminar held in late November by this committee. Among those experts who concurred in the above conclusions were Dr. Norman Hilberry, Argonne National Laboratory; Dr. Henry DeWolf Smyth, former AEC Commissioner now associated with Princeton University; Mr. Chauncey Starr, Atomics International; Dr. Alvin M. Weinberg, Oak Ridge National Laboratory, and Clark Williams, Brookhaven National Laboratory.

The failure of the Atomic Energy Commission to develop a successful atomic energy program and to make possible the development of a private program has more than domestic significances. It is of interest to our allies and to the countries behind the Iron Curtain. Typical of their views, and of international significance, of our atomic energy program are those of Eugene M. Zuchert, who says that America has "disappointed the world and our own people" and that Britain and Russia are way ahead of us. Several distinguished members of this committee who have visited the Soviet Union, have inspected atomic energy installations in that country and in Britain, also report that countries both friendly and unfriendly to the United States are forging ahead while our own program is lagging. I will not burden the record with a recitation of the views of other distinguished scientists and Congressmen, but a cursory review of press releases, newspaper articles, and other documents indicate substantial agreement with the New York Times story of November 24, 1957, which says—

The administration's program to develop atomic powerplants has reached a critical point.

Apparently the response of Admiral Strauss to our own failure and lagging development has been one of continued obstinacy in regard to the authorization of large-scale atomic energy plants. A look at the recommended budget of AEC indicates that the Atomic Energy Commission will not take the initiative in developing a Federal program. The total budget for all atomic energy programs is estimated at around $2.5 billion for the fiscal year 1959. Of this only 5 percent, or about

$125 million, is recommended for research and development of civilian power reactors.

Representatives of my organization, concerned and alarmed at the state of our atomic energy program, have been meeting regularly with national labor, rural electric co-ops, and public power organizations during the past few months. We have come to the following conclusions in regard to civilian atomic power:

1. The attainment of economically competitive electric power using atomic energy is a goal of national importance. Reactor technology has progressed to the point where realization of this goal seems attainable in the foreseeable future, if the Nation supports a strong development effort. It would be a major setback to the position of this country in the world to allow leadership in nuclear-power development to pass out of its hands. (From AEC policy statement of May 26, 1953, with Strauss' concurrence.)

2. A premature decision to relinquish leadership and direction to the privately owned utilities has delayed the development of atomic power in the United States. The utility companies lack the necessary financial and technical resources and economic incentives to discharge adequately this responsibility. The consequence has been serious damage to this country's former position of unquestioned leadership. A further result has been a severe curtailment of opportunities for manufacturers, research laboratories, and engineers to acquire experience and contribute to progress in this new technology and to participate in the growing world market for atomic power facilities.

3. The magniture of the task and the importance of the program require strong, positive, and unequivocal leadership by the Government in accelerating the development of economically practical atomic powerplants. The Federal Government must assert leadership, define clearly its objectives, and establish a civilian atomic power development division so as to elevate the priority and importance assigned to developing civilian application of atomic energy and to vitalize the administration of this program.

4. Existing poliices have resulted in a dispersal of technical manpower in a field where close scientific collaboration and extensive research facilities are essential for rapid technological progress. To make full use of existing resources of technical manpower and development facilities, it is necessary to focus the administration of and responsibility for the program in the Atomic Energy Commission, and to assign responsibility for technical leadership to the Government reactor laboratories—the organizations best equipped to attack the difficult problems involved. Full use also should be made of the resources of other public agencies and the talents of the private equipment and reactor engineering industry in a concerted effort to speed the development, production, and utilization of electric power through the utilization of atomic energy.

5. In addition to continuing the Nation's research program in reactor technology, it is essential to build and operate full-scale prototype nuclear powerplants to progress rapidly toward economically competitive nuclear power. This phase of the Nation's development is most in need of stronger Government leadership.

6. The present state of the art and science of nuclear power technology is sufficiently advanced to make practical the acceleration of

full-scale prototype plant construction. Other countries have such programs underway. It is not in the public interest to rely primarily upon projects undertaken by private corporations to assure this Nation's long-term leadership in the development of low-cost atomic power.

7. Furthermore, the domestic demands for energy are increasing rapidly every year, and continued very large increases are forecast for the future. To help meet the future increases in energy demands, but without displacing fossil fuels as major sources of energy, it is in the public interest to develop atomic energy expeditiously as an additional large source of low-cost electric power.

That concludes my statement, Mr. Chairman.

Representative HOLIFIELD. Thank you, Mr. McDonald. Are there any questions?

We have a statement of Mr. Kenneth A. Spencer, chairman of the National Coal Association Atomic Energy Committee, which he has asked be put in the record. Without objection, this statement will be included in the record of the hearings at this point.

(The statement is as follows:)

STATEMENT OF KENNETH A. SPENCER, CHAIRMAN, NATIONAL COAL ASSOCIATION ATOMIC ENERGY COMMITTEE

My name is Kenneth A. Spencer. I am president of the Pittsburgh & Midway Coal Mining Co., of Kansas City, Mo., and chairman of the atomic energy committee of the National Coal Association. It is in this latter capacity that I appear here today. The National Coal Association is the trade organization of bituminous coal mine owners and operators throughout the United States. Its members mine more than two-thirds of the commercially produced bituminous coal in this country.

We in the coal industry are interested in the atomic energy program not only because atomic energy is another source of fuel but also because the Atomic Energy Commission is one of our best customers. We are concerned, however, over the Gore bill, S. 3000, which appears to be directed toward a crash program in the industrial utilization of atomic energy to generate electricity. Our opposition to this bill is interrelated with existing conditions associated with the present atomic energy program and our views in general as to the development of atomic energy.

With regard to existing conditions, it is our general understanding that the costs of nuclear powerplants as being realized are appreciably higher than estimated, and that nuclear fuel as known is expensive. These conditions are expected to result in nuclear power costs which are far in excess of values competitive with coal-generated power. Because of this, it is understandable that there is no great demand for nuclear power within the United States. This lack of demand and associated high unit production costs contribute materially toward the maintenance of high nuclear power costs. At the same time there are losses by private industry which is helping to pioneer the development of nuclear power.

It is generally accepted that there is no need here in the United States for nuclear power because of the ample supplies of coal and because of the continued, progressive improvement in efficiency in the generation of coal-derived power. There is some lack of unanimity as to how long it will be before it is necessary to depend upon nuclear power in this country. It is, perhaps, unrealistic to elicit the answer to this question from the coal industry. The data, of course, will depend on the use rate, but very exaggerated use rates would fail to endanger our position for several hundred years. At the same time the most enthusiastic reports that we have reviewed on the development of atomic energy place the coal industry in a healthy position by the year 2000. Therefore, it would appear ill advised to enter upon an accelerated program of any nature were it possible to consider only the needs of the American power industry.

We understand, however, that there are substantial demands abroad for electricity derived from atomic energy. We understand that this demand exists

because of less plentiful supplies of coal and that others, for example the British and the Russians, are in a position to supply these needs. It follows, therefore, that there might be an inroad into the atomic energy facet of the United States prestige were we not in a position to build reactors abroad, and conversely our world position would be enhanced by continued leadership in the field.

In its resolution adopted November 1, 1955, the National Coal Association stated in part:

"In progression of humanity, in furthering world trade, in advancing the cause of peace, and in maintaining world leadership of the United States, there is a need to continue government sponsorship of the development of atomic energy * * *

"Further development of economically feasible nuclear power is necessary to provide power for underdeveloped areas of the world, to assist nations that have power shortages, and to protect the future of the United States in the power field. The National Coal Association therefore recognizes the need for the Government to continue the power demonstration program to optimize the conditions under which atomic power is generated."

Substantial progress has been made in the development of atomic energy since the time this resolution was adopted, and it appears that this progress has been in keeping with it. Aside from the several large reactors being constructed, the Shippingport plant has been placed in operation.

We recognize the possibility that it may be necessary to construct additional reactor types to demonstrate United States leadership. However, we have understood that the Atomic Energy Commission has reveiewed the technical aspects of the present systems and has endorsed the several systems now included. We are inclined to agree with this view and see no need to engage in an international kilowatts race.

It is, of course, obvious that lower unit costs on nuclear power systems could be realized with an increase in production rate. However, we disfavor taxing the country as a whole to bring this about, particularly because there is no need for nuclear power in this country, because there is no assurance that such optimized systems would be more economical than coal-fired systems now in use, and because of the apparent high obsolescence of nuclear systems in their present early stage of development.

We should like to suggest that the goals of the Joint Committee on Atomic Energy and those of the National Coal Association as stipulated in its November 1, 1955, resolution on this subject are basically the same. We should like to think that the goals of Senator Gore as outlined in this bill, S. 3000, might be included also. However, in pursuit of these goals and in maintaining the expense of the overall program within reasonable bounds, we should like to suggest that the committee give consideration to the following:

1. Encourage the AEC to allow industry to handle more of its business. In this regard we note that when facilities presently under construction are completed there will be some 15,000 tons of uranium oxide processed annually. Apparently this material will find its way into the Commission circles. We also note that estimates have been made that indicate a mimimum of only about 50 tons of uranium will be used in 1958 in the American power industry, and that this will climb to 170 tons by 1961, and to a maximum of 800 tons in 1965. This represents a substantial difference in materials traffic and, since one of the reasons advanced for accelerating the civilian program is to reduce costs through a larger handling rate, it would appear that more of the AEC's business might be conducted by industry in developing and maintaining a healthy industrial program. We recognize that this would be only a partial solution at best but we believe substantial assistance to industry would result.

2. Build only adequate large reactors to prove technology. This point is directed, of course, at proving and developing technology rather than stimulating economy through mass production. The mass production idea appears to us to be totally unwarranted because of reasons presented earlier.

3. Compete in the foreign market where United States nuclear power is competitive. It is our understanding that reactors being built now by American industry can be produced on a basis competitive with those provided by the British and we should like to encourage this. We should like to suggest that along with this and, of course, within courses of security, a program of fuel allocation be adopted which would make it as convenient as possible for American industry to do business abroad.

Representative HOLIFIELD. The next meeting will be Monday at 10 o'clock in room 304, Old House Office Building.

(Thereupon at 3:15 p. m., Friday, February 21, 1958, a recess was taken until Monday, February 24, 1958, at 10 a. m., in room 304, Old House Office Building.)

(NOTE.—The hearings of Monday, February 24, 1958, and Tuesday, February 25, 1958, pertaining to uranium problems, have been printed separately together with a portion of Wednesday, February 19, 1958, entitled "Problems of the Uranium Mining and Milling Industry.")

DEVELOPMENT, GROWTH, AND STATE OF THE ATOMIC ENERGY INDUSTRY

WEDNESDAY, FEBRUARY 26, 1958

CONGRESS OF THE UNITED STATES,
JOINT COMMITTEE ON ATOMIC ENERGY,
Washington, D. C.

The Joint Committee met at 2 p. m., pursuant to recess, in room 1334, New House Office Building, Hon. Carl T. Durham (chairman of the Joint Committee) presiding.

Present: Representatives Durham, Price, and Patterson.

Present also: Representative Overton Brooks.

Also present: George E. Brown, Jr., and Richard Smith, staff members.

Chairman DURHAM. The committee will come to order.

This afternoon we will have to reverse our schedule a little bit because we would like to accommodate people who have to catch planes and other transportation.

The first witness this afternoon will be Mr. J. Robert Welsh, president of the Southwest Atomic Energy Associates. Will you come around, Mr. Welsh?

We are glad to have you with us. Sit down there, and you may proceed as you care to.

STATEMENT OF J. ROBERT WELSH, PRESIDENT, SOUTHWEST ATOMIC ENERGY ASSOCIATES

Mr. WELSH. Mr. Chairman and gentlemen, I certainly thank you for the invitation to appear before your committee.

Chairman DURHAM. Thank you very much. We are very glad to have you, Mr. Welsh.

Mr. WELSH. I am J. Robert Welsh, president of Southwestern Gas & Electric Co., an operating electric utility serving parts of Texas, Louisiana, and Arkansas. I am also president of Southwest Atomic Energy Associates. This organization has as its members 15 electric utility companies operating in the States of Arkansas, Kansas, Louisiana, Missouri, Mississippi, and Oklahoma. These companies and the location of their principal offices are:

Arkansas-Missouri Power Co., Blytheville, Ark.
Arkansas Power & Light Co., Little Rock, Ark.
Central Louisiana Electric Co., Inc., Alexandria, La.
Gulf States Utilities Co., Beaumont, Tex.
Kansas Gas & Electric Co., Wichita, Kans.
The Kansas Power & Light Co., Topeka, Kans.
Louisiana Power & Light Co., New Orleans, La.

Missouri Public Service Co., Kansas City, Mo.
Mississippi Power & Light Co., Jackson, Miss.
New Orleans Public Service, Inc., New Orleans, La.
Oklahoma Gas & Electric Co., Oklahoma City, Okla.
Public Service Company of Oklahoma, Tulsa, Okla.
Southwestern Gas & Electric Co., Shreveport, La.
The Empire District Electric Co., Joplin, Mo.
Western Light & Telephone Co., Inc., Great Bend, Kans.

Most of these companies have been members of one or more atomic-power study groups during the past few years, and are familiar with the prospects and the problems in utilizing the heat energy from atomic fission for the generation of electric power. Toward the latter part of 1956, our interest in the possibility of using atomic energy was increased by a new reactor concept which had prospects of producing electric power at a cost competitive with conventional plants and conventional fuels.

In deciding what direction our efforts should take, we determined that we should have two primary objectives: (1) To contribute to the advancement of power-reactor technology, and (2) to look toward the ultimate construction and operation of one or more large atomic-power plants of a size between 200,000 kilowatts and 400,000 kilowatts of electrical capability giving promise of competitive generation of electric power in the area served by Southwest Atomic Energy Associates' participating companies.

Prior to the formation of Southwest Atomic Energy Associates, the four operating electric companies comprising the Middle South Utilities System requested manufacturers or designers of reactor systems to submit proposals designed to meet our two objectives. We received four such proposals.

After a detailed analysis and comparison of four proposals and material submitted by a fifth company, all our members of Southeast Atomic Energy Associates concluded that what was needed in our case was a reactor of advanced design with high-performance characteristics. This is due to the fact that the service areas of the companies comprising the associates are in a section of the country where present costs of fossil fuels for power production are relatively low, thus making it more difficult for atomic power to become competitive there than in many other parts of the country.

We selected the proposal submitted by the atomics international division of North American Aviation, Inc., as holding the greatest prospect of meeting the criteria we had established.

The North American concept contemplates an advanced epithermal thorium reactor, a promising idea not being actively pursued by the Government or other industry groups. The reactor, as its name indicates, would operate in the epithermal, or intermediate, neutron range and would use the thorium-uranium-233 fuel cycle. Sodium would be the coolant and graphite, or perhaps beryllium, would be the moderator. It would include a blanket containing thorium breeder elements, and the economic performance of a full-scale plant is largely contingent upon the approach to breeding which can be achieved.

The principal advantages expected of the advanced epithermal thorium reactor are:

1. Good neutron economy.
2. High temperature operation.

3. Compact core.
4. Practicable for generating stations of large capacity.
5. Reduced xenon problem.

Preliminary analysis indicates that this reactor concept might be capable of producing electricity in our service areas at a cost comparable with that obtainable from other fuels if built in the future with capacity of from 200,000 to 400,000 electrical kilowatts.

Encouraged by a report with so much promise, our associates have undertaken a research and development program which will lean heavily on nuclear physics and critical experimentation, in order to confirm or disprove the anticipated favorable economics of this system and to secure essential data for the design of a full-scale plant.

It is our hope that when this research and development program is completed we will have enough facts and information upon which to base a decision as to whether or not it would be practicable for any of the sponsoring companies to proceed with the construction of a phototype plant, or with development of components for a full-scale demonstration plant. Obviously, such a research and development program is necessary, regardless of who might be interested in the advanced epithermal thorium reactor.

The uncertainty about the actual achievements of such a reactor, and about its economics, is great enough to preclude the immediate construction of a full-scale plant. In fact, the uncertainty is so great as to preclude the immediate construction of even a pilot plant.

On January 15, 1958, Southwest Atomic Energy Association announced the signing of a contract with North American Aviation, Inc., to carry out the necessary research and development work, and such work is now underway at North American. It is anticipated that about 4 years will be required to complete the work and that expenditures under the contract will be approximately $5,300,000.

Southwest Atomic Energy Associates intends to finance the entire cost of research and development, and to rely upon the Atomic Energy Commission only to make available necessary quantities of special nuclear materials, including uranium-233, sufficient for critical experiments and for other physics experiments, and to make available certain Atomic Energy Commission facilities if the type required is not otherwise available to the Southwest Atomic Energy Associates program. No decision has been reached as to whether or not Southwest Atomic Energy Associates will request a waiver of fuel use charges for the special nuclear materials required for the program.

Several discussions have been held with members of the staff of the Atomic Energy Commission and we have been encouraged by their interest in our project. General K. E. Fields, General Manager of the Atomic Energy Commission, wrote to us on July 24, 1957 as follows:

> We have reviewed with great interest the program planned for development and improved evaluation of an epithermal thorium breeder reactor. This program appears to be a logical extension of work now in progress in the Commission's program for the development of sodium cooled graphite moderated civilian power reactors. As indicated in your letter, there remain important technological uncertainties which must be resolved for a more realistic appraisal of this approach to the achievement of economically competitive nuclear power. This program you describe appears to offer technology of a worthwhile value which would be supplemental to work presently being conducted.

The members of Southwest Atomic Energy Associates are convinced that the advanced epithermal thorium reactor shows great promise of being able to produce competitive electric power, and we have pledged the funds necessary to complete the research and development work on which the design of a large reacctor will be based.

The information developed under our contract with Atomics International Division of North American Aviation, Inc., will be available to each of the members for the purpose of preparing designs or estimates on an electric power plant utilizing a nuclear reactor.

Based on the outcome of the studies and experiments, the members either individually, or in association with others, will be able to go ahead with a nuclear powerplant, depending upon the economic feasibility of such a plant in competition with the fuels available in each company's service area.

If, after completion, the studies prove that the advanced epithermal thorium reactor will live up to its promise of low-cost construction and operation, a complete nuclear powerplant could be built and placed in operation in a short time.

On behalf of Southwest Atomic Energy Associates, I wish to express our appreciation for the opportunity to appear here today.

Chairman DURHAM. Thank you very much, Mr. Welsh. I want to congratulate you on pushing back what I believe to be the frontiers of some of these scientific problems that are involved in these different types of reactors. You are taking on a job here entirely new, which I am happy to see you people in that section doing, because you know the intent and purpose of this whole thing is to explore and find out as far as we can definitely how we can produce power as cheap as we can in whatever type of reactor.

Despite it having been in the research and development stage for the last several years, we are still in that stage today, I think.

I congratulate you and your companies for taking on this type of a project, because I think it is worthwhile and will be useful in future years to come, if it is not now.

Mr. WELSH. Thank you, sir.

Chairman DURHAM. Thank you for your contribution to our hearing, which is a little different. The thing that is a little different in yours from the rest of them, most of them have accepted research and development funds. I notice here you state you are going to do this all on your own private individual firms' funds. Is that correct?

Mr. WELSH. Yes, sir.

Chairman DURHAM. You are spending your own money?

Mr. WELSH. Yes, sir.

Chairman DURHAM. You are not expending Government money?

Mr. WELSH. No, sir.

As I pointed out there, of course, we have to get the uranium from the Government for the critical tests that are required.

Chairman DURHAM. Of course. We understand that.

Mr. WELSH. We have to get that.

Chairman DURHAM. The cost, as far as that has been concerned, has been agreeable with the group?

Mr. WELSH. Oh, yes.

Chairman DURHAM. I do not think you will have any trouble with that, because that is a very low-cost factor compared to what we are putting in some of the others. The know-how we have already developed in the Commission we want to be free to all of the groups coming in in this research and development program.

Mr. Price?

Representative PRICE. I was very much interested in your statement, Mr. Welsh, because evidently you are looking into an area which might be termed one of the gaps in the Commission's reactor program. I am certain there is not any project of the nature you are getting into included in the power development program at the present time.

In your explorations, as you go into this program, have you been able to obtain much knowledge of the amount of work that the Commission itself has done in the use of the uranium-233 thorium cycle?

Mr. WELSH. Of course, it is my understanding that there is some work going on now, or just starting, on that uranium-thorium cycle. I believe it is at Arco, Idaho. We are assured that the work proposed by the Atomics International under our contract would supplement and would carry forward some of the work that the Commission would like to have carried on and which we were told, if we do not carry on, the Government would probably have to do it.

Representative PRICE. You indicate an enthusiasm in your contemplation of this program, based on the promise of being able to produce competitive electric power, and I believe you leave the impression in your statement that you might be expecting that in your first large scale plant. Is that true?

Mr. WELSH. Well, it is our belief that, if they do not run into great difficulties with fuel elements, the reactor itself will be relatively small and compact for the amount of heat it will produce, and that the cost should not be in proportion to the cost of small reactors that have been built to date, and that the combination of those factors would work toward a low cost for the heat if we would direct our efforts toward a large-sized generating station. And that is what we are trying to do when we are talking about in the neighborhood of a 200,000- to 400,000-kilowatt capacity.

Representative PRICE. Do you envision the first reactor station to produce from 200,000 to 400,000 kilowatts?

Mr. WELSH. I think we would. If these experiments prove up, all of the studies—and the gentlemen assure me that it is not a question of being able to do it, it is a question of whether or not they can do it was economically as they think they can, and that if the studies prove up that it can be done as economically as they think, I think we will get a recommendation from Dr. Starr to build a large-sized generating station.

Representative PRICE. You put the time on these studies at around about 4 years?

Mr. WELSH. Yes, sir.

Representative PRICE. If they did prove out, theoretically at least, in that time stage that they would be capable of producing economically competitive power, how long would it take to construct such a station?

Mr. WELSH. I would say offhand about 3 years.

Representative Price. How do you compare the possible cost of such a station as compared with some of the other types of reactors that we have in the program today?

Mr. WELSH. Of course, reactors in the program so far have all been so expensive that we could not work up any enthusiasm for them, because, for instance, a $300- or $400-per-kilowatt capital investment does not appeal to us in an area where we are building these plants for a hundred dollars a kilowatt or less.

Chairman DURHAM. Are you doing that on conventional plants now?

Mr. WELSH. Yes, sir; on gas-fired conventional plants.

Chairman DURHAM. That is about the lowest in the country. Then, is it not?

Mr. WELSH. Yes, I think that area is about the lowest in the country in there.

Chairman DURHAM. It is usually $150.

Mr. WELSH. Yes, sir. On coal-fired plants it runs up a little bit more.

Representative PRICE. What are you hopping for here?

Mr. WELSH. We are hoping we will get down around the hundred dollars a kilowatt.

Representative PRICE. Are such hopes held out to you by the people who are doing the research and development?

Mr. WELSH. Yes, sir. They think that the reactor itself would not have to be a real large—I am talking about physical size—real large one, and that the cost of that reactor, if all of these things prove up, should get down in an area where this will be competitive, and that is the whole hope of our program.

Representative PRICE. What have you actually done in this project up to this time?

Mr. WELSH. I signed this contract on behalf of the Associates on the 13th of January, and I was in California 2 weeks ago right now, on Tuesday, Wednesday, and Thursday, at Atomics International, and they were, of course, just getting some men working on those nuclear physics. But they are actually working on the project and trying to get in more finite shape the actual outline of their conception.

And then the studies that they will make, particularly on nuclear physicis, as to whether or not it proves up on their studies what you might say they have visualized or thought of in making this proposal to us. The proposal made to us is a firm-priced proposal for these studies and for the experiments.

Representative PRICE. That is a firm price. Is that the $5,300,000 figure?

Mr. WELSH. Yes, sir.

Representative PRICE. That is a firm-price proposal and contract with you for all research and development?

Mr. WELSH. Yes, sir.

Representative PRICE. That will lead up to a prototype?

Mr. WELSH. Our contract states that after the completion of the studies—I believe they referred to it as a zero power test, anyhow, which will take at least a year on running these various tests, which is really the test with uranium-233—that at the end of that time the

contract provides they will give us recommendations as to whether or not we can go ahead with the construction of a large-sized reactor for a large-sized powerplant, or if we should go through this intermediate stage of—they did not call it a prototype—anyhow, a small reactor to prove up something perhaps that they were not able to prove on the reactor that they will be building in connection with this research and development contract.

Representative PRICE. Can you give any greater evidence of interest and encouragement on the part of the Commission itself than the letter from the general manager that you quoted in your statement?

Mr. WELSH. In a discussion that I recall here recently on this trip to California, I was told by one of the staff members that they were very happy we are going ahead with the contract, and that they think this type reactor holds a great deal of promise.

Is that something along the line you had in mind?

Representative PRICE. Yes. I just wanted to know whether they had expressed some enthusiasm themselves on you and North American going ahead to fill what evidently is a gap in this program, and whether they thought it should be filled, whether it is something worth exploring.

Mr. WELSH. Yes; I think we feel we have that assurance from the Commission's staff.

Representative PRICE. That is all I have, Mr. Chairman.

Chairman DURHAM. A good many of the scientists, of course, have suggested further work in this area for the past several years, in the U-233 field.

Mr. WELSH. Yes, sir.

Chairman DURHAM. You say you have Dr. Starr as your consultant?

Mr. WELSH. Yes, sir.

Chairman DURHAM. You have a very good man.

Mr. WELSH. Yes, sir; we have a great deal of confidence in him.

Chairman DURHAM. He is probably as knowledgeable as any man I know of in this field at the present time.

Mr. WELSH. Yes, sir.

Chairman DURHAM. Of course, I think after listening to the scientists over the past several years, U-233 does hold quite a pretty good promise because it is hotter material and probably producing more thermal heat than U-235.

I am particularly glad to see you get into this field because I am very interested in the type of reactor and think it may prove to be very useful. The more heat you get, the cheaper you get it.

Mr. WELSH. Yes, indeed.

Chairman DURHAM. I suppose that is the main reason for your getting into this type of reactor.

Mr. WELSH. Oh, yes.

Chairman DURHAM. We have with us Congressman Brooks from down in your section. Do you have any question, Congressman?

Representative BROOKS. No, Mr. Chairman and gentlemen, except to say that I have known Mr. Welsh for many years. He is doing a great job heading a great combination of companies down there. Of

course, he has the benediction of all of us that want to see development in the lines of atomic energy.

I am happy to be here with you and listen to the testimony and the questions. I want to thank you for the cordiality of your treatment.

Chairman DURHAM. We are certainly glad to have any Member with us who is interested in this field. It is well established today it is not competitive, but I think in making plans for the future we have got to look to the use of any type energy we can.

Mr. Welsh, thank you very much for coming.

Mr. WELSH. Thank you again for the opportunity, sir.

Chairman DURHAM. Admiral Leggett, will you come around?

Mr. LEGGETT. Yes, sir.

Chairman DURHAM. We are glad to have you with us. Thank you for stepping aside to accommodate Mr. Welsh so he could catch the plane.

Mr. LEGGETT. I am very glad to have had the opportunity of listening to Mr. Welsh's statement, sir.

Chairman DURHAM. You may proceed with your statement.

STATEMENT OF W. D. LEGGETT, JR., VICE PRESIDENT, ENGINEERING SERVICES, ALCO PRODUCTS, INC., SCHENECTADY, N. Y.

Mr. LEGGETT. Mr. Chairman, on behalf of Alco Products, I should like to thank the committee for the opportunity of appearing this year to report progress and make some suggestions I trust will be helpful in furthering the development of nuclear power. Let me say first that I have reread my statement to the committee last year. It still appears to present a good case for the small nuclear powerplant.

In the area of progress I am happy to report that we successfully completed the Army Package Power Reactor in April of last year. Subsequent to that time this reactor has operated for a total of about 10 months in accordance with schedules laid down by the Army. During these operations we have generated 7½ million kilowatt-hours of electricity which has been utilized on the post at Fort Belvoir.

A number of "firsts" are associated with the APPR–1 project: It was the first nuclear-power project undertaken under a fixed price, guaranteed performance contract for a complete nuclear powerplant. It was the first to use stainless-steel-clad fuel elements with light water as the coolant and moderator. It was the first nuclear powerplant to be designed, erected, and operated in advance of an accelerated schedule agreed to as a change under the original contract. The successful completion of a rigorous 700-hour performance test within the contract period was characterized by the Atomic Energy Commission as an important "first."

A 6-month operating contract was completed last month and a new contract entered into for an additional 18 months' operation of the plant by Alco. During all operation, the performance and stability of the plant has exceeded our expectations. Except for minor mechanical and electrical derangements, which might normally be encountered in operating any new power installation, there have been no unscheduled interruptions of operation of the plant. None of these shutdowns were of a nuclear nature.

The reliability of this plant has been remarkable for so new a de-

velopment. You might say that it was essentially a trouble-free operation. This means two things:

First, that the plant is suitable in its present state of development for isolated independent stations and, second, we have not yet begun to realize the full capability of our present nuclear powerplants. In other words, we have not yet begun to push these plants to the point where troubles begin to show up. Normal development requires that we do this, find what the weak spots are, correct them, and move on to still higher outputs.

The fact that a pressurized water nuclear plant is suitable for remote bases could be an item comparable to its suitability for ship propulsion. In spite of this proven capability and the manifested advantages of nuclear power for isolated locations, there exists an understandable reluctance on the part of the services to devote appropriations to the development of nuclear power when they can achieve their power requirements by more conventional means.

This is more readily understood when the cost incurred in making an installation in an isolated area, particularly in the Arctic, is considered. We are faced with the fact that regardless of the promise which nuclear power holds and with the cost of fuel at even remote bases, it does not show an economic advantage.

This is not surprising. The Navy has gone ahead with the development of nuclear power, of diesel engines and of steam powerplants under similar situations.

I recall a report of the Secretary of the Navy in 1851, more than 100 years ago, where the copper boilers of the steam frigate *Mississippi* were replaced by iron boilers. The speed of the ship was doubled, the cruising radius was increased by 20 percent and the sale of the scrap copper was sufficient to pay the total cost of the change. I remember this because it is one of the few cases I know of where progress was not painful and expensive.

I am well aware that the Army and the Air Force have carried on comparable or even greater developments. The difficulty with respect to nuclear power lies in the fact that it is not a requirement of the highest urgency insofar as remote bases are concerned. On the contrary, it has the handicap of being another new problem to be handled in an already complicated construction job.

In the circumstances, I think the services are to be commended for the consideration they are giving to the furtherance of nuclear power as a national resource. They have shown repeatedly that they are aware of the advantages to be gained logistically. I would like to make it very clear that I, for one, feel that they are doing a common-sense and commendable job in this development and that they will not let the development die.

Progress will be slow, however, unless some additional support is given to installing atomic power where it does provide the best, if not the least expensive, solution to a national need. Such additional support could be provided through the Atomic Energy Commission or directly to the Department of Defense. A sum of fifty or one hundred million dollars which could be used to pay some portion, possibly half, of the amount by which the cost of the nuclear powerplant exceeds the cost of a conventional powerplant would give considerable impetus to this program.

I suggest this would have the merit of utilizing to the best advantage our present capabilities in nuclear power. It would result in the accelerated development of powerplant types which will eventually find a use not only in the military applications but industrially, abroad and in this country. Whether or not such acceleration is warranted, I believe, is a matter of determination by this committee.

With reference to the foreign situation, I outlined to this committee last year the arrangements which we had made with two firms in England for the sale, erection, and manufacture of certain components for nuclear powerplants for which we would construct in this country the nuclear elements and core.

I would say that the results so far have been disappointing but not surprising. We have made a great many contacts and have a number of interested prospects. While we are sure that some of this interest is mainly curiosity, we know that there are several who are serious and will purchase a nuclear plant when and if certain obstacles can be overcome.

The most important of these obstacles is cost. Thanks to lower cost of special equipment and the higher price of coal abroad the economic gap is much narrower than it is in this country. Still we need the development to be gained from about two more generations of powerplants in order to make our plants economically attractive in England and Western Europe.

Somehow we propose to get these two generations of powerplants built. There appears to be some reluctance on the part of governments in the area mentioned to encourage the importation of American designed powerplants. It would seem, therefore, that this may be a slow and difficult negotiation unless this Government decides as a matter of policy that financial assistance to manufacturers in selling nuclear plants abroad for some limited number and time is warranted.

This question of national policy has, I believe, been fully discussed in this committee. It is my understanding that we do want the United States to continue as the leader in the development of nuclear power in the world. The economics involved in making our plants attractive in Western Europe are probably even more confused than in our own country.

It appears, however, that some step equivalent to furnishing the first fuel loading free or for a nominal charge would be required. Of course, any developments made incident to such construction would automatically be available for national developments at some later date.

Another obstacle which we customarily encounter is the reluctance of any foreign national to be dependent on the United States for enriched uranium which, as you are aware, is necessary for the small light-water-moderated reactor.

It would be most helpful if the Atomic Energy Commission were authorized to give assurance through the manufacturers that a supply of enriched uranium will be guaranteed for the life of any reactors sold abroad at the present time.

In the area of research and development, we urge that the Commission's program be stepped up. We appreciate that this program has been increased consistently but we feel that with the state of the industry and availability of personnel today a further acceleration of this

program is both practicable and desirable. We accordingly would recommend that these funds be increased by about $100 million over the last year's appropriations.

I am keenly aware of the difficulty of stepping up a reactor design by 5 or 10 times its present size. For this reason, I fully concur that we do need to build some large power stations in order to determine what these problems are. Many of the problems can be, however, ironed out in small reactors. This permits faster progress in that construction and test schedules can be greatly expedited.

I would also like to reemphasize the fact that we can take nonnuclear risks in the construction of small reactors which would be entirely unjustified in large ones. With all our scientific and engineering skills we still must do a certain amount of learning from the mistakes that we make.

I should also like to reemphasize the fact that Alco is firmly of the opinion that there is a place, and will be for a long time in our power production, for the small reactor as an independent power station in its own right. As a Nation, we still consume twice as much energy in small power and heating plants as we do in central station power generation.

Thank you again, sir, for the opportunity of being before you today.

Chairman DURHAM. Thank you very much.

I think most of what you have advocated here this committee has been advocating for a good many years. We feel like the program should be stepped up. We feel like, of course, if we expect to do any business in Europe there has got to be some change in our policy in regard to fuel at the present time.

I think we sensed this year when we were in Europe six weeks or more, talking to all of these governments in Western Europe, that the one thing they are concerned about is whether or not they are going to be able to get the supply of fuel when and if they do get their plants.

Mr. LEGGETT. This is a major matter of concern; yes, sir.

Chairman DURHAM. I think it is a major matter, myself. I agree with you.

I feel—of course, I do not mind expressing my own personal opinion, not the committee's—that is one of the things we should take into consideration in our whole foreign-relations program, because, as I sense the situation over there, that is one thing they have necessarily got to have if they expect to advance economically. And some of these other programs we have, I think this is far more important than anything I see in Europe today in their present economic condition. I may be wrong, but I am just speaking my own opinion.

Mr. LEGGETT. It is one I happen to share.

Chairman DURHAM. I think we should immediately take some action to try to solve this problem. We primarily adopted the 1954 act to cooperate more fully with the countries in the peaceful use of the atom, and we are at the point now where I think we must take some action.

Mr. LEGGETT. We are advocating that we do, sir. We feel that, while we are going to somehow get this job done, as I have emphasized, this is going to take some additional support somehow from industry in Western Europe or England which is willing to pay a premium for it, as some of our American utilities have done, or by another sacrifice

on the part of ourselves and our European affiliates to carry the excess cost of this, or by some help from a foreign government, or by some help from our own government.

Chairman DURHAM. We have just completed with the raw materials group of people from the West on the matter of raw material, which, of course, today we have got almost jamming up our back doors so we cannot get out.

Mr. LEGGETT. This I know, sir.

Chairman DURHAM. With the situation of need in Europe like it is, to me it is just good common business sense, if we expect to continue our plants in the manufacturing business in this country at the present time which are capable and qualified to produce this material, then we need it for two purposes, I think:

For the future long-range problem that we all know exists here in America, for which it is not competitive today, and in our weapons program which we must keep going. It can serve a twofold purpose to do something to supply them with the available amount of raw material in this country.

Mr. LEGGETT. Mr. Durham, could I emphasize once more that what we feel is the need to go through two more generations of this powerplant with an objective of reduced cost.

Chairman DURHAM. That is right.

Mr. LEGGETT. In other words, this means increased output and reduced capital costs. There are two things: double the output and halve the costs are my goals.

Chairman DURHAM. That has happened in all of the power-development facilities.

Mr. LEGGETT. They are very conservative estimates. Looking back over the years at the power developments, these are quite conservative estimates compared with the diesel engine or steam plant at the same period in its development.

Chairman DURHAM. You made one statement there in regard to the Services being in the position of having to accept the conventional plant because of the cost, and in regard to the isolated places. Would you elaborate on this just a little bit?

Mr. LEGGETT. Yes, sir.

Chairman DURHAM. Having built the first one, of course, which is designed primarily for this type of purpose, supplying energy for these isolated places in all parts of the world. We have great hopes this thing will serve a great purpose. Do you feel like it could be placed around the world economically competitive with the cost of power? Do you think it is or is not?

Mr. LEGGETT. The factor which I am afraid I had not properly evaluated before, Mr. Durham, is the cost of the installation in these remote places. I, frankly, have very limited access to information on this cost of installation, in the Arctic particularly.

We have been exposed to a couple of jobs to be done, and we have come up with prices on those jobs. One of them is confidential, by the way, so I could not use it. But it is indicative to us that the nuclear powerplant, unless we can find some other way to get it into the Arctic, or unless we get it down to something that can be moved in as a package without the installation problem—and we are working on both of these ideas—when you add to a new development the cost of

research and development and the fact that it is an unknown, the contingencies which are put in by the erection contractor or the arbitrary formulas which are used are sufficient, really, to price this out of range.

I think that it is going to need some help to get it done. I believe that, once it is done, once we have made the first breakthrough and people know what it costs instead of just being worried about what it costs, the problem will not be nearly as bad as it now appears to be.

Chairman DURHAM. You pioneered in this field, of course, I guess, with the hope that this thing would be successful in supplying the Services primarily in these isolated places with this type of engine.

Mr. LEGGETT. That is right, sir.

Chairman DURHAM. Has there been any cost factor on Fort Belvoir yet?

Mr. LEGGETT. On the cost of generating?

Chairman DURHAM. Yes.

Mr. LEGGETT. Of course, we will not know the full cost of generating until we begin to come to the end of the first core. Then we know what we are getting in the way of burn-up with the stainless-steel technology.

Our estimates, Mr. Durham, on what this electricity will cost, based on our capital costs and based on our estimate of 14 megawatt years for the core, is somewhere between 50 and 55 mills. I would not care to make it any closer than that. We have come up with an exact figure, but I do not think we should use it.

Chairman DURHAM. That is about like Shippingport which, of course, is a much larger plant.

Mr. LEGGETT. Yes, sir; it is a little bit less than the last figure I saw for Shippingport.

Representative PRICE. That is what Shippingport thought it was going to be?

Mr. LEGGETT. Yes, sir.

This we attribute primarily to the stainless steel technology, I suppose, and perhaps we are overoptimistic in how long our core is going to last. So far, we have about four and one-half megawatt years, and it seems to be going along about on the curve.

Chairman DURHAM. But the operation has been successful?

Mr. LEGGETT. Phenomenally successful, in my opinion, Mr. Durham.

When I found out what kind of a contract my company had signed for this after I first got up here, I was scared to death.

Chairman DURHAM. Mr. Price.

Representative PRICE. Admiral Leggett, you have listed this as one of the first fixed-price nuclear power projects undertaken. I think that is true.

Mr. LEGGETT. Fixed price?

Representative PRICE. Yes.

Mr. LEGGETT. Yes, sir.

Representative PRICE. How did Alco come out on the deal?

Mr. LEGGETT. We made considerable contribution to it. In the circular which was distributed down at Belvoir, I think we estimated the cost of the plant, as such, was about $3½ million. In later figures we have revised that up to about $3.8 million. And then we have a research and development bill on top of that of about a million dollars.

So that the figure we used in connection with the cost of power generated was $4.8 million.

Representative PRICE. What, in round figures, was your excess of costs over what you bid on the job? Can you tell us that?

Mr. LEGGETT. Our actual excess cost—and, once again, it is not entirely fair to attribute all of this, because some of the research and development we would have done anyway—but about between 2 and 2½ million dollars over and above the money which we received from the Army.

Representative PRICE. Over the price agreed to?

Mr. LEGGETT. Yes.

Representative PRICE. I remember the justification for the Fort Belvoir project, and Mr. Durham has touched on it in some of his questions. It was presented as a portable-type reactor that the Army could move and ship quickly into the isolated areas we have been talking about.

Do you think that poses some problems now and this actually does not turn out to be a portable reactor? Is that correct?

Mr. LEGGETT. It was not designated as a portable reactor.

Representative PRICE. It was never so designated, but the impression was given it was something that could be quickly shipped to the isolated areas in the world, and we sort of pictured it as being of great value particularly in our DEW line operations.

Mr. LEGGETT. Yes, sir; I think that impression did get abroad. The APPR stands for Army package power reactor, which is not portable.

Representative PRICE. I know what it stands for. Would you still say it could be described by the word "package?"

Mr. LEGGETT. Yes, sir. It is not he last word in packaging, as I told the committee last year. We have been primarily concerned with getting it to run, but it can be broken down into packages which are air transportable. The APPR one could. This was our goal at that time. Now we have moved on to the next step in this program, and we are trying to make it so it will be much more readily transportable and can be put together easily, and do the things you are talking about.

Representative PRICE. What do you picture in that area? What do you vision that we could do in the area of a package reactor that could be of service in a few years to the military?

Mr. LEGGETT. This entails some decisions on the part of the military or the Atomic Energy Commission as to how much safety you are going to require in these remote areas.

Representative Price. Let's take it just as a military project entirely, and that you make some concessions that you would not make for civilian use, and so forth.

What is the best job you could do in setting up a reactor similar in size to the one at Fort Belvoir and in that category?

Mr. LEGGETT. Mr. Price, we have a study on that underway right now. I have the preliminary on it in my briefcase, as a matter of fact, and we are turning it over to the Army. It is one we are making as a company. It is not an Army project, by the way.

We feel that we can put together a reactor packaged so that it can be put into the field and hooked up in any of these places, and in

very short order. In other words, it will not require permanent structure. We will have to have a mat it can sit on in a permafrost area. The design is not complete at this point, but it looks like a perfectly practical thing to do.

Representative PRICE. What kind of a time are you thinking of?

Mr. LEGGETT. To do the hookup and start the plan and operation?

Representative PRICE. Yes.

Mr. LEGGETT. I would say it would be a matter of weeks. We have not come up with a definite answer on that as yet, sir, but the connections will certainly—you have got to get in there, got to level——

Representative PRICE. As far as the Fort Belvoir project itself is concerned right now, that in itself would not lend itself to the definition of a package reactor, would it?

Mr. LEGGETT. The Fort Belvoir unit as it stands today certainly is not a package reactor in the term that we generally think about it.

Representative PRICE. What did you learn most from that reactor about meeting the military needs that were stated at the time that they went into the program?

Mr. LEGGETT. For one thing, we learned, as I tried to emphasize in my statement today, that you can do this even in its present state of development, and put it together, and have a very reliable powerplant. This, I would say, is No. 1.

Another thing that we did learn is that the packaging is not adequate, and we have been working on that practically even since to improve the packaging. We have come up with a couple of ideas on it, and we have done the study for the Army on another reactor, as a matter of fact, besides this one.

Representative PRICE. Did you read the testimony given before the committee by another company in regard to a package reactor and what they are doing on it?

Mr. LEGGETT. Last year before the committee?

Representative PRICE. No; last week.

Mr. LEGGETT. No, sir; I have not seen it. This would be Martin Co., I presume.

Representative PRICE. I think the testimony given here was that they were working on a reactor that perhaps seven planes would be sufficient to transport. Do you feel that may be the next step beyond the Fort Belvoir project?

Mr. LEGGETT. I feel it is a practical figure; yes, sir.

Representative PRICE. You are making studies along that line now?

Mr. LEGGETT. Yes, sir; we have made several studies along the line, not for the APPR itself, for smaller reactors. And we are now making one for the APPR practically in its present form.

Representative PRICE. In your statement, the second last paragraph on page 2, where you are talking about your contact with some of the prospective foreign buyers in this field, you said: "I would say that the results so far have been disappointing but not surprising."

I think you have also answered that somewhat in your replies to Mr. Durham, but I would like to pose this question: Do you think we could have a little better result if, rather than insisting upon the sale of the fuel, we could have some leasing arrangement on the fuel with prospective foreign buyers?

Mr. LEGGETT. It would help some; yes, sir. I am sure it would help some, because when the change was made from the question of

the United States financing at 4 percent to a question of the buyer putting up the full cost of the first unit to start with—this has been a change the other way.

Representative PRICE. Have you run into any obstacles in your own dealing with prosective foreign purchasers because of the fact that they could not lease the fuel?

Mr. LEGGETT. Yes, sir.

Representative PRICE. In other words, this is a pretty costly inventory for them to carry?

Mr. LEGGETT. This is correct, sir. It means financing, and whether the rate is 4 percent as we had previously been doing it, or whether the rate is 5 or 5½ percent, which is what they say they will have to pay for it, I do not think it is the determining factor. It is rather the factor of having to raise this additional capital that bothers the prospective purchaser.

Representative PRICE. That is all I have.

Chairman DURHAM. Mr. Patterson?

Representative PATTERSON. No questions.

Chairman DURHAM. Thank you very much, Admiral Leggett.

Mr. LEGGETT. Thank you, Mr. Durham and Mr. Price.

Chairman DURHAM. The next witness is Dr. Zalman Shapiro, president of the Nuclear Materials & Equipment Corp. We are glad to have you with us.

STATEMENT OF ZALMAN M. SHAPIRO, PRESIDENT, NUCLEAR MATERIALS & EQUIPMENT CORP., APOLLO, PA.

Dr. SHAPIRO. Thank you, Mr. Chairman.

I am Zalman Shapiro, president of Nuclear Materials & Equipment Corp., of Apollo, Pa.

By way of background, Nuclear Materials & Equipment Corp. is primarily a manufacturing concern for the supply of materials to reactor fabricators. For instance, we convert enriched and natural uranium hexafluoride into fuel compounds, such as uranium oxides, carbide, and sulfate. We also fabricate these compounds into pellets, dispersions, and so forth.

In addition, as some of you may know, we recently received the first license which has been issued for the conversion of hexafluoride into enriched uranium metal. We also do melting and welding of reactor materials; unirradiated scrap recovery; and perform testing services, such as corrosion testing, metallography, physical testing, and chemical analysis. As an adjunct to these production and service activities, we carry out research and development on problems related to materials production.

When I appeared before this committee in last year's section 202 hearings, I pointed out the need for an accelerated and intensified effort toward the solution of materials problems, if economical nuclear power is to be attained. These problems remain among the most serious bottlenecks in the atomic energy program today.

In this area, because of fiscal considerations, on which I am not competent to express a judgment, a number of importance programs have suffered delays. The alternate control rod program is an example. Another is the development work on the fast oxide breeder

reactor, which could contribute considerably to the economical utilization of plutonium as a reactor fuel.

If we hope to progress, we cannot let research and development suffer first every time there is a desire to reduce the budget. Research and development must be carried forward with continuity and vigor. We must make a determined effort to solve our problems in a systematic manner, through a continuing comprehensive program, rather than relying primarily on stopgap, disconnected, relatively narrow investigations which are limited to specific immediate reactor construction difficulties.

Aside from the materals problem, I believe the program would be strengthened if more effective provision were made for the utilization of the contributions of smaller business concerns.

Despite the frequently expressed sentiments in favor of small business, and the statistics which are compiled on its participation in the program, the fact remains that smaller concerns face many stumbling blocks in attempting to enter the atomic energy field.

One is an intangible—a matter of attitude. The personnel who place contracts for the program seem to feel that they are personally more vulnerable to criticism if they deal with a small concern, and something goes wrong with a contract, than if they had been dealing with a larger concern.

This fear of criticism also expresses itself in another attitude, which is based on an assumption that public policy condemns new enterprises. I do not pretend to understand the origin of this strange notion. Yet we have found a widespread attitude that contracts with new companies are disfavored because they would constitute "setting you up in business," and this the Government must not do.

This leads to the paradox that, while many large companies have had entire plants and divisions provided them by the Government under multi-million-dollar cost-type contracts, there is some reluctance to consider on the merits competitive proposals by new smaller companies, which have established their own facilities. I believe the people who have this attitude are honest, but that they are mistaken.

The Congress can make an important contribution to the competitive character of the industry by making it clear that public policy does not disfavor contracts with new companies as such, and that, in fact, the entry of new competitive enterprise into the atomic energy field is to be encouraged.

This concern about "setting companies up in business" carried over into the field of cost-plus-fixed-fee contracts, where, for instance, we are told that interest is a disallowable overhead item under all circumstances. Yet many smaller companies do use bank or other institutional financing, in addition to the funds invested by their stockholders, to install capital facilities.

This can be a perfectly sound way of obtaining the expensive equipment necessary to operate in this field, and interest is an entirely legitimate overhead expense of such a firm.

If such a firm can provide better quality or service at a competitive total price than a richer company which may not need to borrow money, why should the smaller firm not be permitted to allocate a fair share of its fixed costs to its Government business, when the Government prefers to contract on a cost-plus-fixed-fee rather than fixed price basis?

The most serious problem for a new small concern in this field is getting on bidders' lists for Commission contracts and subcontracts.

The choice of firms which are invited by Atomic Energy Commission installations and contractors to bid on Government-financed work is often an individual, subjective process on the part of purchasing agents or project engineers who, while they are undoubtedly conscientious, have only haphazard means of informing themselves of the capabilities of firms which should be considered for specialized work in this field.

As a result, contracts are let in the Commission program on the basis of an inadequate solicitation of bids, perhaps not intentionally, but because of inadequate machinery for dissemination of information among the responsible purchasing personnel.

Big business can afford large staffs of sales engineers to visit Commission installations all over the country to solicit business. Written requests to be placed on bidders' lists are, however, ineffective. A smaller concern often finds itself with no means of persuading purchasing personnel at distant localities of its competence to perform Commission business, and hence is not even requested to submit bids and demonstrate its capacity.

There should be a procedure under which, at a licensee's request, the Commission would inspect the licensee's facilities to determine its technical qualifications and circulate an inspection report to all Atomic Energy Commission installations and contractors. A licensee which appears to be qualified under such an inspection should be automatically placed on the bidders' list of all Government installations, and of all Government contractors which subcontract for the products and services in the area of that licensee's indicated competence.

The procedure I am suggesting would not deprive the contracting firm or office of its ultimate responsibility for evaluating bids and awarding contracts. It would, however, insure that the Government has the benefit of bids from all qualified firms which wish to bid, and that all qualified firms get a fair opportunity to submit a competitive bid for consideration. This situation does not prevail today.

An additional problem exists in regard to repository libraries of classified technical information. Several of such libraries have been installed for the benefit of access permittees, but more are needed. There is none, for instance, in the Pittsburgh area, one of our major centers of industrial atomic activity.

An access permittee located in western Pennsylvania has an unclassified library in its vicinity, but for complete reference work in classified materials, it must either send its personnel to Oak Ridge or maintain its own complete reference library. This may not involve an excessive financial burden for a large company; a smaller concern is at a serious disadvantage.

If more repository libraries of classified information cannot be made available, it would be helpful if access permittees could be permitted use of the libraries in Atomic Energy Commission installations such as exist in the Pittsburgh area. These library facilities are not, in my experience, overburdened, and reasonable limitations could be put on the number of visits which permittees would be permitted, the type of documents they could see, et cetera.

We understand the question of increasing repository library facili-

ties has been under study for some time, and feel it merits the full encouragement and support of the Congress.

Access to the results of Government-financed research is also impeded by long delays before information is published. While the Commission's Technical Information Service is very cooperative and efficient in distributing information once it has been released for publication, this is often a matter of many months or even years after the reports have been prepared. In the meantime, if this information is required on other projects, it is often necessary to duplicate the original research independently, at considerable expense and loss of time, in order to arrive at the same information which has already been developed elsewhere.

Because of the limitations of time, I have discussed a few of the problem areas where improvements seem in order. There are, of course, others which also merit scrutiny. I would not wish, however, to minimize the accomplishments which have been made, nor the cooperation which firms in the nuclear energy industry have so often received from the Commission.

The attitudes I have discussed are not universal and I doubt that they represent official policy at the Commission level. The courtesy and intelligent helpfulness which we have been accorded on many occasions by personnel of the Commission would, I am sure, be most gratifying to this committee, and should be acknowledged.

In closing, I should like to express my appreciation for the opportunity to appear before this committee and present our views on the status of the program.

Chairman DURHAM. Thank you very much, Doctor.

I think what you say here prevails not only in this agency but it prevails in many other agencies of the Government. That has been my experience as a Congressman in trying to help little business. I always found a lot of things that seemed to be in the way of giving the contract and securing the information on how to do it or how to go after it.

Dr. SHAPIRO. Yes.

Chairman DURHAM. What type of contracting are you qualified for?

Dr. SHAPIRO. We are qualified in my own particular firm to do anything in the materials line from the standpoint of research and development on ceramics, chemical things, as well as metallurgy. We are also qualified to do manufacturing of reactor materials.

Chairman DURHAM. How long has your company been organized?

Dr. SHAPIRO. We have been organized since December of 1956.

Chairman DURHAM. 1956?

Dr. SHAPIRO. Yes. We have been in business a little over a year.

Chairman DURHAM. Did you ever work with the Commission at any time?

Dr. SHAPIRO. We have actually no contracts at the moment with the Commission. We have contracts with firms which are contracting with the Commission. We have contracts with firms such as Atomics International, Martin Co., Westinghouse, and others in that category.

Chairman DURHAM. Do you have any contracts at all with the Commission?

Dr. SHAPIRO. We have had no direct contract with the Commission,

and we find it quite difficult to push anything through that we feel has merit.

Chairman DURHAM. You are doing only subcontracting, then, at the present time?

Dr. SHAPIRO. Yes. We are hopeful for the acceptance of some contracts.

Chairman DURHAM. What was your background before you went into this type of business, Doctor?

Dr. SHAPIRO. I was at Bettis at the inception of the entire operation. We were only some 25 people, I think it was, in a small office in downtown Pittsburgh when I started with Bettis.

Prior to that, I was at the research laboratory with the Westinghouse Electric Corp.

During the time I was at Bettis, I had positions of responsibility in the materials development field. For example, I was responsible for the design and the research and development that went into the plant for the production of pure zirconium which was used in connection with the construction of the *Mark I* and the *Nautilus*, and subsequent to that I set up the corrosion facilities which are important in this field.

Chairman DURHAM. How long were you at Bettis?

Dr. SHAPIRO. For some 8½ years.

Chairman DURHAM. Then you have had a good deal of experience in their operation?

Dr. SHAPIRO. I have had a tremendous amount of experience in this field.

As a matter of fact, the people in our firm have had a tremendous amount of experience. We have people who were at the Knolls Atomic Power Laboratory and at the Bettis plant, as well as people who were formerly associated with the Bureau of Standards in the atomic-energy field.

So we have a good deal of competence accumulated in our organization.

In addition, we have a good deal of very expensive and excellent equipment which has been put in at the expense of our stockholders with no promise at all of any business in the atomic-energy field.

Chairman DURHAM. How much did your plant cost you?

Dr. SHAPIRO. We have put into the plant at this time roughly $450,000.

Chairman DURHAM. That must be quite a nice laboratory.

Dr. SHAPIRO. Yes, it is. We are very proud of it.

Chairman DURHAM. I think your complaint is justified.

I do not apply that to just one agency, but all the agencies of the Government.

It seems very difficult for people to pry open the lid and get contracts. To me it is a fine idea to distribute this throughout the country to small business.

Dr. SHAPIRO. We have been particularly amazed at the difficulty of getting on the bidders' list of such places as Oak Ridge and Argonne National Laboratories and other such facilities. In spite of the fact that we have written to these places on numerous occasions, we have yet to receive in some cases requests for quotations, although we do receive indirectly requests from other concerns that have been asked to bid as a subcontractor.

Chairman DURHAM. Mr. Price?

Representative PRICE. I can appreciate your problem. We have had contact with numerous small-business enterprises throughout the country, not limited to the atomic-energy field, who run into similar difficulty in seeking information.

I do not think it is due to lack of desire on the part of the AEC to make information available. It is a difficult problem to find a system that is completely workable, but my experience has been that the AEC has always been most cooperative.

I frequently have had the task assigned to me of trying to help small business operations in my own area get on the bidders' list of various Government agencies. Sometimes they are successful and other times they seldom hear of work prospects. The problem of an agency seeking to find the type of industry qualified in fields that would come within certain specifications, also enters the picture.

I do not know what it is, but it is a problem. I am sure it is not any attempt on the part of any Government agency to foreclose any bidders.

The problem has been with us for a long time. I would like to know the solution to it. I think perhaps in your case you have more or less enumerated some answers in your own statement.

You state the success of the larger companies and the reason they are successful, and your handicap of being unable to follow the same procedure, you do not have the personnel or finances that the big organizations have.

I think it is something that we should try to help to solve because I believe there is a need, particularly in a new program of this sort, to develop new business. I do not think there should be any tendency on the part of anybody who is in this program to be fearful of awarding a contract because it may be setting up a new company in business.

I think we should welcome new operations in this field.

In one part of your statement, as a matter of fact, in the paragraph on page 3, you say:

> While the Commission's technical information service is very cooperative and efficient in distributing information once it has been released for publication, this is often a matter of many months or even years after the reports have been prepared.

Would you like to elaborate on this, how this might come about, or what causes this?

Dr. SHAPIRO. In any project, which is being conducted, there are a number of internal reports, progress reports, and other reports of this nature which are generated and circulated within the project itself. This represents reports on research and development and other items which are currently in progress in the organization.

It is this sort of thing that does not get disseminated because of the fact that in some cases perhaps the information is of a somewhat preliminary nature, or the project itself is not complete, and so on.

So there is hesitation to release this information for publication.

Nevertheless, from the standpoint of anybody working in this field this information is of the utmost importance and, consequently, there should be some means to disseminate this information as it is being generated.

I know that in my own case there have been reports which I, myself, have written—I left Bettis over a year ago—and one report which

was probably written about a year and a half to two years ago has just been released by the Office of Technical Information. This is just an example. This has to do with one of the hazard reports in connection with the Shippingport pressurized water reactor.

But this is a small example.

Representative PRICE. I am convinced there are adequate grounds for you to be concerned about these matters. I think that you have given the type of statement here which is not merely one for the record, but I think it is something that the committee should explore to see if some of these things cannot be corrected.

Dr. SHAPIRO. Mr. Price, in connection with the point you previously made about helping small business, perhaps it might be a good idea to consider an office of small business within the Atomic Energy Commission itself which would have the responsibility to inform small business of opportunities, to "bird dog" the Commission to make sure that they are inviting bids from small business.

Representative PRICE. What are you reading from there?

Dr. SHAPIRO. This is a little addendum which I have here.

Representative PRICE. If you have recommendations to make on this, go ahead and make them.

Dr. SHAPIRO. This is one recommendation I would like to make. I think it would be extremely helpful if such an office were set up. There is another problem which I have not mentioned too, and that is in connection with the supply of nuclear materials for naval reactors.

The naval program is supplied primarily by the Atomic Energy Commission for their special nuclear materials. It would be very helpful to have private business in a position where they could also supply these special nuclear materials, the enriched uranium.

Chairman DURHAM. Are you getting the information out of the industrial information service now?

Dr. SHAPIRO. Yes, we get information from the office.

Chairman DURHAM. Industrial information that is set up in the Commission?

Dr. SHAPIRO. This is the new information agency that has just been organized.

Chairman DURHAM. I do not know how long it has been in existence down there. It has been in existence for several years as far as I know.

Representative PRICE. Do you ever hear from them?

Dr. SHAPIRO. No; we do not.

Representative PRICE. I think, however, the initial approach must come from interested people. Your suggestion is that they have an office where interested companies in the field can make their interests known and then it would be a matter of permanent expression of interest so that whenever anything is about to be let out for contract, that all prospective bidders would have some idea that something is brewing, that something is going on.

Dr. SHAPIRO. Yes, that would be extremely helpful, Mr. Price.

Representative PRICE. Do you have any other suggestions that you think you could make on some of these matters you had in your statement?

Mr. SHAPIRO. There is some other matters that need attention. One is a matter of insurance, I know there has been a recent expression on the part of the Congress for participation in the insurance of reactor operators.

The same thing should hold true with respect to participation in insurance of other licensees using or manufacturing special nuclear materials, subjected to the same hazards; we are insured by the same groups, and the insurance rates are out of this world.

Representative PRICE. I do not know what the rates are, but I am pretty certain that you are covered by the indemnity legislation. Any contractor, any subcontractor or licensee, anyone that is involved in the work that would come within the provisions of that law, no matter whether you are a prime contractor, subcontractor, as long as you are involved in the project.

Chairman DURHAM. The Advisory Committee on Industrial Information was formed in 1949 just for this purpose, as I understood it when it was set up. As to how it functions, I do not know.

Representative PRICE. It may be, Mr. Chairman, if we went into the functions of that office it may be that that office itself might be in a position to correct some of the matters which you brought to our attention in your statement.

Chairman DURHAM. I think the statement merits some explanation from the Commission.

If you have no objection, I am going to send a copy of it to the Commission for comment.

Dr. SHAPIRO. I have no objection at all.

Chairman DURHAM. Mr. Patterson?

Representative PATTERSON. Doctor, how many people do you employ?

Dr. SHAPIRO. Thirty-five.

Representative PATTERSON. Your investment is $400,000.

Dr. SHAPIRO. Our capitalization is actually higher than than. The investment in plant and equipment is $450,000 so far.

Representative PATTERSON. How much work have you done to date for the Commission?

Dr. SHAPIRO. We have done no direct work for the Commission to date. We are currently negotiating a contract with Bettis.

Representative PATTERSON. All your work to date has been subcontract work?

Dr. SHAPIRO. Subcontract work from other organizations, such as Atomics International.

Representative PATTERSON. I was interested in the statement you made here where you said on page 2:

> A smaller concern often finds itself with no means of persuading purchasing personnel.

What do you have to do with persuading some fellow down here in the Government who is in control of handing out some contracts?

Dr. SHAPIRO. You see, the problem is this, Mr. Patterson. Generally when a private concern in the atomic energy business or the Government is interested in letting a contract, they will inspect the facilities of the proposed contractor.

Representative PATTERSON. Yes, but you know when the contract is being let they have to be publicized.

Dr. SHAPIRO. In some cases they do, and in some cases they do not. We recently had occasion where—well, I guess it was just an oversight, we were excluded and yet we were very well qualified.

Representative PATTERSON. Excluded you on what ground?

Dr. SHAPIRO. I think it was simply an oversight, but there are many of these.

Representative PATTERSON. Many oversights?

Dr. SHAPIRO. Many oversights; I think so.

Representative PATTERSON. That is a serious accusation. If you are sure that there is favoritism being shown——

Dr. SHAPIRO. No, I am not saying that. I am saying that there are certainly a number of firms that are qualified and interested and we are among them, and I am sure that it was not intentional that we have been excluded.

Representative PATTERSON. On how many occasions were you excluded?

Dr. SHAPIRO. There have been several. We were hit by one very, very recently, the details of which I would not like to go into.

Representative PATTERSON. Is there any reason why you should not go into them from the point of view of jeopardizing your own concern with respect to your competitors?

Dr. SHAPIRO. Well, I would not like to jeopardize our position with respect to the Commission. We do not want to create hard feelings.

Representative PATTERSON. If I were sitting down there as a commissioner, and you made a statement to the effect that you could not even be put on the mailing list of bidders, I would wonder about that and I would certainly look into it.

Dr. SHAPIRO. We have an extremely difficult time getting on the mailing list. This is something which is up to the individual engineers, the project officers, and the purchasing agents themselves, to be convinced that this firm of ours is a firm with which they can do business.

Representative PATTERSON. Why?

Dr. SHAPIRO. We are a new concern; we have people who are extremely well qualified. Yet it is a matter again of this attitude. Because we are a new concern, well, we have not been tried on the——

Representative PATTERSON. That is on the part of the Commission.

Dr. SHAPIRO. It is an attitude on the part of those people who are in a position to let contracts. I do not think this is an official Commission attitude.

Representative PATTERSON. Specifically, who are these people?

Dr. SHAPIRO. People in purchasing positions, or contract-letting positions, who are lower down in the field, but who are the ones who actually do the letting of the contracts.

Representative PATTERSON. There must be somebody of responsibility in those positions.

Dr. SHAPIRO. I presume that the chief purchasing agents or managers of purchasing are responsible for these things; what we would like to do is to have, as I mentioned in my prepared statement, at our invitation a visitation to our plant, our facilities, interviews if you like, with our personnel to demonstrate our competence along certain lines and the reports on these things should be circulated to all Government installations and contractors so that they would constitute an official bidders' list.

Then I think we would all get a fair opportunity to do this work. I think that is a matter of time. People have to get used to our presence, have to be convinced we are competent and capable.

Representative PATTERSON. How long have you been in business?

Dr. SHAPIRO. Over a year.

Representative PATTERSON. In that length of time, how many subcontracts have you had that relate to the Atomic Energy Commission?

Mr. SHAPIRO. All of our business has related to the atomic-energy field. I think we have had something like in the twenties or thirties.

Representative PATTERSON. Have you had any rejects on the part of your contracting concern on the work you have done?

Dr. SHAPIRO. No. We are extremely conscious of our position in this thing; we want to build a reputation and we are, therefore, I think, a lot more conscientious in turning out a good job than perhaps a larger outfit that can stand some setbacks in this regard.

We know that one slip on our part can jeopardize our position for all time.

Representative PATTERSON. Whom have you contacted specifically at the Atomic Energy Commission with respect to getting some business?

Dr. SHAPIRO. We have written letters to the chief purchasing agents of all the Government facilities that we know of, such as Oak Ridge, Argonne, Bettis, and at GE, and so on. We also have written letters to some of the technical people, the project people who would be in a position to let or initiate contracts of this sort.

Chairman DURHAM. You would operate through the field office primarily, would you not?

Dr. SHAPIRO. We operate through the field offices, but we have also written, of course, to——

Representative PATTERSON. In reply to your requests what have you received? Have you received an outright "No," or have you received any encouragement?

Dr. SHAPIRO. In some cases, in fact, we have not even received replies.

Representative PATTERSON. Mr. Chairman, I will go along with your recommendation that this statement of the doctor's be sent to the Atomic Energy Commission with a very strong letter from the committee asking them to give us an explanation why a concern, regardless of whether it is big or small, and a legitimate concern, cannot be placed on the bidders' list.

Chairman DURHAM. Thank you very much, Doctor.

Dr. SHAPIRO. You are very welcome. Thank you again, Mr. Chairman.

Chairman DURHAM. The next witness is Mr. Lee L. Davenport, president of the Sylvania-Corning Nuclear Corp.

Mr. Davenport, we are very glad to have you with us. You may proceed.

We have to be out of here in 13 minutes. Can you comply with that request?

STATEMENT OF LEE L. DAVENPORT, PRESIDENT, SYLVANIA-CORNING NUCLEAR CORP.

Mr. DAVENPORT. I think so.

My statement is preceded by a 2-page summary which, of course, I will skip.

Chairman DURHAM. We will place your statement in the record if you just want to comment on it.

Mr. DAVENPORT. I would like to read the testimony in full, if I may.

Chairman DURHAM. All right, you may proceed.

Mr. DAVENPORT. During the last 9 months it has become increasingly evident that we have reached a crucial junction in the further development of a thriving domestic nuclear-power industry.

During that period there has been a growing realization on the part of the Government and industry alike that, in view of the abundant natural resources with which our country is endowed, the Elysian goal of economic nuclear power in this country is considerably further off than most had anticipated.

The effects of this realization have been further aggravated by the success of the Commission in attaining its frequently expressed objective of encouraging private industrial participation in the development of the nuclear program. This objective has been so successfully achieved that a marked imbalance has resulted between the number of industrial firms participating in the field and the total amount of work available.

This, in turn, has developed a buyer's market so strong that unwise and uneconomic commitments are widely accepted in our industry.

Consequently, an increasing number of responsible firms have already terminated or announced their intention to terminate their nuclear activities.

I firmly believe that this has created and will continue to foster an unhealthy industrial base for our industry and in the long run will inevitably retard its development.

Under the circumstances there is an immediate and serious need for a basic reevaluation of the goals sought to be achieved by our industry.

In the absence of immediate economic incentive, it seems clear that development and continuance of private nuclear-power development must rely heavily for the immediate future on some form of Government assistance.

However, it seems clear to me that such assistance cannot be justified in the absence of compelling national objectives which it may be expected to help achieve.

There can be little disagreement that a kilowatt race as such can scarcely be justified on these criteria.

A determination as to the nature of our fundamental national objectives must necessarily be made by Congress in conjunction with the Executive.

However, I believe that there are certain basic assumptions with respect to such objectives on which there would be little disagreement.

1. In the light of the present worldwide conflict between the free world and that dominated by the Soviet Union, it is imperative for us to shape our national policies in such a way that nations already friendly to us will remain within and if possible become even more

closely integrated into the free-world camp, and that uncommitted nations will wish to join with us.

Achievement of this result will obviously be affected substantially by the degree to which we can convince our friends and allies that with the free world they may achieve a higher living standard in time of peace and will have a greater chance of survival in time of war.

2. To this end, as evidenced by our experience with sputnik, we must defend and to the extent possible, enhance our position of world leadership in science.

Furthermore, it is not sufficient that we merely continue to maintain leadership in the development of so-called advance concepts; the ultimate test of our leadership must necessarily rest in our ability to put these concepts to practical use.

3. We must evidence our willingness to share with our allies and friends the peacetime benefits of our higher standard of living including those derived from practical applications of our scientific leadership.

4. Finally, if our objectives are to have meaning to ourselves and our friends, they must be achieved to the maximum extent possible consistent with—indeed, by virtue of—the successful operation of our free enterprise system.

Objectives 1 through 3, supported by our experience with sputnik, would appear to justify an integrated program for the development of nuclear power which will be practically useful and economically competitive with other sources of power available to the free world directly or from Soviet-dominated countries.

Basic research and development work toward such end in this country would, of course, be required.

Even more important, I feel that such a program to be effective would require demonstration of its practical applicability by construction of a number of nuclear reactors for the generation of nuclear power within the United States, at rates competitive with foreign power costs.

Through their very existence and the publicity which would attend their construction and operation, a practical demonstration might be given of our scientific leadership and the concrete uses to which it might be put in advancing a nation's living standards.

As I have indicated, to be attractive to our foreign friends, the cost of power produced by any reactors constructed by us must compare favorably with the cost of power sources presently available abroad.

I would suggest, therefore, that a goal be established of 5 to 10 full-scale power reactors within 5 years, each to generate electric power at a cost of 15 mills per kilowatt-hour, or less, and at an installed plant cost not to exceed $300 per electrical kilowatt.

Furthermore, if objective No. 4 is not to be ignored, such a program must be conducted with a minimum of Government control and interference and with maximum utilization of the processes of our free-enterprise system.

This would preclude any prior decisions on the part of the Government as to what types of reactors should be constructed, and by whom.

The output and cost goals once set, it should be left to free competitive enterprise—which has been so successful in this respect throughout our country's history—to select the types of reactors that might best meet these goals.

Any combination of a reactor manufacturer and a utility group should be permitted to approach the Commission with a reactor proposal intended to meet the established goals. The type of reactor which the combination would propose would be of little consequence, subject only to certain minimum conditions and understandings:

1. It must obviously meet applicable health and safety criteria.

2. It must represent a type which could be successfully utilized by foreign nations which we wish to favorably influence.

It must be recognized that most foreign nations do not have an available supply of U–235. Therefore, reactors making use of highly enriched fuels may not be attractive to our foreign friends unless we are prepared to make U–235 available to them with a minimum of controls and restrictions and under the same conditions as it is made available domestically.

Finally, successful participation by domestic private enterprise in such a program would require statutory provision of economic incentives for the achievement of the determined goals.

By the same token, if such a program is to take advantage of the naturally selective processes of the free-enterprise system, participants must be expected to risk some part of their own funds if they fail to achieve established goals.

To achieve these ends, I would propose that suitable legislation be enacted to permit electric utilities either singly or in combination to receive rapid depreciation of no longer than 5 years on plants and facilities which the Atomic Energy Commission authorizes for participation in the program.

Provision should also be made for any additional tax incentives which might be necessary to make up the difference to participating utilities between the cost of conventional power—approximately 8 mills per kilowatt-hour—and the 15 mills sought to be attained by the program.

Additional incentive would thereby be provided automatically for the attainment of anything better than 15-mill power.

Further additional incentive might be specifically provided if the goal of installed cost of $300 per electrical kilowatt is bettered. The participating companies' own funds would automatically be at stake to the extent that the desired goal of 15-mill power is not achieved.

Successful achievement in this country of 15-mill power within 5 years would focus attention upon this Nation's concern over the rapidly materializing shortages and increasing costs of fossil fuels in other nations of the world. It would make available to such other nations a source of power which would be attractively competitive with their presently dwindling sources.

Furthermore, in order to help raise the living standards of friendly nations in time of peace, it would be appropriate that some part of our foreign-aid budget be allocated to the requirements of those friendly nations which need such power sources, but cannot at present afford to purchase or develop them.

Legislation might be enacted to permit the utilities or governments of such friendly foreign nations to enter into a contract with a United

States manufacturer of such reactors with the understanding that up to 50 percent of the cost of such reactors to the foreign utility or government would be borne by the United States Government under its foreign-aid program. Such a suggestion has already been made by others and appropriate legislation may already have been drafted to achieve this end.

Finally, I would like to comment briefly on the part which Commission procurement practices may play in the development of a healthy nuclear industry and, indirectly, in the achievement of the goals I have already outlined.

Whatever may be the success of the program I have suggested, there is little question that our industry must rely heavily for its support in the next 5 to 10 years on Government contract work. To this extent it becomes increasingly important that Commission procedures and policies reflect some of the fundamental needs of a free and competitive economy.

Time permitting, I might go into lengthy detail on the effects on our industry of various aspects of present Commission procurement practices, including many of those required by the 1956 act as well as many developed on the Commission's own initiative.

Present patent and proprietary information policies, security and export restrictions, accounting practices, and proposed indemnity policies under the reactor indemnity amendment are but a few examples of those which I feel call for detailed review if the attainment of the Government's expressed objectives is not to be impeded.

More fundamental, however, is the need for reassessment of the manner in which the Commission's procurement practices as a whole are developed and implemented.

In the long run the objectives of the Government and, necessarily, of the public, will be best achieved by development of a healthy industry capable of efficiently and expeditiously meeting the nuclear needs of the Nation.

A necessary step toward this end is the development through consultation with industry, of integrated procurement policies, published and available to all, and uniformly applied in similar circumstances.

I strongly commend the long-run advantage of such policies in helping to achieve the expressed objectives of the Nation's nuclear program, over the possible alternative of procurement practices based upon confidential, a priori, case-by-case application, conditioned by a supervening interest in getting each job performed at a minimum of financial or other obligation on the part of the Government and without regard to fundamental problems of the individual contractor or the industry as a whole.

A useful example of the preferred alternative I have suggested might be derived from the procurement policies of the Department of Defense. While obviously not perfect, they have the advantage of many years of successful usage and are based on the fundamental premises of consultation, publication, and uniform application that I have suggested and over the years they have proven themselves to be sufficiently flexible to meet changing needs and effective in the development of a cooperative and healthy industrial base serving effectively in peacetime and available for immediate expansion in time of crisis.

Thank you, Mr. Chairman.

Chairman DURHAM. Thank you very much, Mr. Davenport. We are glad to have you outline your plan here trying to solve this problem.

I know the committee is very glad to have it.

Mr. Price, do you have any questions?

Representative PRICE. Several witnesses have made references to the indemnity provision recently enacted into law. What was your thinking when you mentioned some of the things that have to be explored? You mention among them proposed indemnity policies under the reactor indemnity amendment. What were you thinking of when you put that in your statement?

Mr. DAVENPORT. If I may, I would like to call on Mr. Howard Cohen, secretary and counsel to our corporation, who has made a specific study of indemnity legislation and policies.

Representative PRICE. There have been several references to it this afternoon. I certainly would like to hear from Mr. Cohen.

STATEMENT OF HOWARD H. COHEN, SECRETARY AND COUNSEL, SYLVANIA-CORNING NUCLEAR CORP.

Mr. COHEN. Thank you, Mr. Price and Mr. Chairman.

I think there are a number of aspects of the proposed policies that call for review.

First, I think, is a need for a meshing of the indemnity policies of the Commission with the proposed insurance policies.

There is also a need for liberal interpretation of the provisions of the indemnity amendment if its purposes are to be effectively carried out. Just by way of example of one area calling for such interpretations, the proposed insurance policies will cover any liability and risk during the course of transportation at least within the continental United States. The proposed indemnity policies of the Commission, to date are entirely unclear as to whether the risks during transportation will be covered.

This is one of many examples that need study and need a development of regulations and policies which will assure the industry and the public of adequate protection in accordance with the purposes of the amendment.

Chairman DURHAM. Is that not a matter of insurance being worked out in detail?

Mr. COHEN. Regarding my specific examples of risks during transportation within the continental United States, the insurance covers most of the area. The question is will Government indemnity pick up beyond the insurance to cover the risk in transportation. The interim regulation for licensees on financial protection requires $250,000 of financial protection.

Let us take the example of Syl Cor as a subcontractor selling fuel elements to X company. We know in any shipment from an operator-customer's facility to our facility that we will be covered for $250,000 liability.

Beyond that we don't know if we are covered.

The Commission has not yet come out with any interpretation of the act or definite wording of the act telling us that we will be covered by its indemnity during the course of transportation.

The act merely says that all parties will be covered under a statutory indemnity granted to the operator to the extent that the liability arises from activities at or in connection with the operation of the reactor.

Now, does the Commission believe that transportation is within that criterion? We think it is but we don't have a definitive statement from the Commission on that yet.

Chairman DURHAM. Is that the Commission's responsibility, or the insurer?

Mr. COHEN. The insurer tells us he will cover us in the amount he is required to cover us, $250,000. Beyond that point there is a statutory indemnity applicable, but we don't know if it covers the transportation risk. We assume it will, but we don't know.

Another example is perhaps a little different than this one. That is, what happens during the interim period. The Commission has not yet developed definitive indemnity policies. What happens to Government contractors in particular—since that is the field in which the Commission policy is least definitive right now—what happens to us on any liability that may be incurred by us due to incidents prior to the time that the Commission comes forth with a definitive policy?

Will the Commission under the "existing authority" provision of the amendment continue its previous contract policy?

Will any indemnities which they finally grant be retroactive to the date of the enactment of the statute?

We don't know. We are waiting for an answer to this.

Another aspect of the Commission's proposed indemnity policy which I think calls for review, is the implementation of the Price-Anderson amendment with respect to material licensees under the license section of the amendment and to suppliers of special nuclear materials and fuel elements under the Government contract provisions of the amendment.

As Mr. Price correctly stated before, the indemnities granted to the operator of the facility will clearly cover the product liability of the supplier, but they will not cover the liability of the supplier at his own site.

It may be that his liability is not of the sort that meets the statutory criterion of presenting a hazard to the public.

I don't believe any of us are in a position to say.

Representative PRICE. It will cover the manufacturer of a containment vessel?

Mr. COHEN. It will cover his product liability only under present policy which is to grant the indemnity merely to the facility operator.

It will cover the supplier of the containment vessel in your example, on his product liability after it gets to the reactor site.

Representative PRICE. Do you mean—when the vessel is fabricated at the subcontractor site with a flaw that might cause an accident on the site of the reactor, that subcontractor is not covered?

Mr. COHEN. That subcontractor is not covered under present Commission policy.

Representative PRICE. Is that a matter of policy or how do you interpret the law itself?

Mr. COHEN. The law leaves coverage of that sort as it relates to public liability to the discretion of the Commission.

Chairman DURHAM. Have you asked for a definition?

Mr. COHEN. We have. The Commission, as you undoubtedly know, conducted a series of hearings in December of last year and January

of this year. The hearings were primarily on the licensing side, but we have suggested to the Commission that a study be made on the hazards involved in these other activities for which they have discretion to grant indemnity, that the study be of the same general nature of the Brookhaven report on reactor hazards.

That if it is found in fact that there are no substantial hazards of public liability, that no direct indemnity be granted.

But if there are situations—and we think there may be some, such as the fuel element fabricator at his site—if there are situations involving hazard to the public—that indemnity be granted directly to those suppliers.

Now, I do not know what the status of this is at the Commission today.

The contract side presents an even more serious problem. This ties in with Dr. Davenport's testimony toward the end of his statement.

Despite constant urging on the part of the industry the Commission's policy on the contract side has tended to be one of development of policies and procedures without consultation with the industry. We have urged the Commission to consult with industry as to the best way of implementing, among other things, its Price-Anderson indemnity program as well as its existing authority, apart from Price-Anderson, on the contract side.

Representative PRICE. Did I understand Mr. Davenport to say that you made a study of the indemnity legislation and policy of the Commission as it related to the act?

Mr. COHEN. In connection with two of my committee activities, Mr. Price, we have made extensive studies.

Representative PRICE. I was wondering if such a study might be available to this committee so that we could look it over and see what some of your interpretations are and then relate it to the policy of the Commission.

Mr. COHEN. Mr. Price, I am not at liberty personally to say it would be. I would be happy to bring this back to the two committees in which I am a member in one case and chairman in another case, and ask for their approval to submit such data.

Representative PRICE. We would appreciate having it.

Mr. DAVENPORT. These are both committees of the Atomic Industrial Forum. It is through the agency of the forum that these studies are being carried out.

Chairman DURHAM. Thank you very much, Doctor. We have not time to explore this fully this afternoon, but we certainly would like to study the comments and some of your suggestions along the line.

We know it is a new act and we never will know how the thing works unless we hear from those who are affected by it, who operate under it.

Mr. DAVENPORT. Thank you, Mr. Chairman. We very much appreciate the opportunity you have given us to appear before your committee.

Chairman DURHAM. Thank you very much, Doctor.

There will be no meeting tomorrow.

The meeting will reconvene Friday morning, February 28, at 10 o'clock in room 304 in the Old House Office Building.

The committee is adjourned.

(Thereupon, at 4 p. m., Wednesday, February 26, 1958, the committee was recessed, to reconvene at 10 a. m., Friday, February 28, 1958.)

DEVELOPMENT, GROWTH, AND STATE OF THE ATOMIC ENERGY INDUSTRY

FRIDAY, FEBRUARY 28, 1958

CONGRESS OF THE UNITED STATES,
JOINT COMMITTEE ON ATOMIC ENERGY,
Washington, D. C.

The Joint Committee met at 10 a. m., pursuant to recess, in room 1334, New House Office Building, Hon. Carl T. Durham (chairman of the committee) presiding.

Present: Representatives Durham, Holified, Price, Jenkins, and Hosmer.

Present also: James T. Ramey, executive director, David R. Toll, staff counsel, and George E. Brown, Jr., staff member, Joint Committee on Atomic Energy.

Chairman DURHAM. The committee will come to order.

This is a continuation of the hearings under section 202 of the Atomic Energy Act of 1954 on the development, growth, and state of the atomic energy industry.

The first witness this morning is Mr. Jack K. Busby, president of the Pennsylvania Power & Light Co.

Mr. Busby, you may come around.

STATEMENT OF JACK K. BUSBY, PRESIDENT, PENNSYLVANIA POWER & LIGHT CO.

Mr. BUSBY. With me is Dr. Johnson, the Westinghouse manager of the project. We will present this together, if we may.

Chairman DURHAM. Have you a statement, or how do you care to proceed, Mr. Busby?

Mr. BUSBY. Dr. Johnson will really present here this morning a summary of the rather full technical report which we have submitted to the Joint Committee, but which, of course, is too voluminous to permit reading.

Chairman DURHAM. All right; you may proceed.

STATEMENT OF W. E. JOHNSON, PROJECT MANAGER, ATOMIC POWER DEPARTMENT, WESTINGHOUSE ELECTRIC CORP.

Mr. JOHNSON. Thank you.

On February 26, 1957, there was submitted to the Joint Committee on Atomic Energy a statement on the origin, objectives, and progress to date on the single-region homogeneous slurry power reactor project, generally known as the PAR project.

It is the purpose of this statement to present the current status of the project and to outline the plans and objectives for the future.

The project was initiated in mid-1955 as a joint program by Pennsylvania Power & Light Co. and Westinghouse Electric Corp. to ascertain the feasibility of building a large-scale nuclear powerplant on the Pennsylvania Power & Light Co. system utilizing the homogeneous type of reactor.

Expenditures to date have amount to $5½ million.

Recently Baltimore Gas & Electric Co. has joined the project in connection with the further work planned for 1958 and 1959.

Chairman DURHAM. Why did they join with you, Doctor? They were not a member of the original group, were they?

Mr. JOHNSON. I believe not. Mr. Busby can answer the question better than I.

Mr. BUSBY. We have talked with several utility companies as this program has developed, with a view of broadening the base of participation.

Baltimore Gas & Electric Co. is one company that has decided to join the group and participate in the further research program for 1958–59.

We think this is a very worthwhile expansion of the base of the program.

Chairman DURHAM. I do, too.

Proceed, Dr. Johnson.

Mr. JOHNSON. On December 11, 1957, Pennsylvania Power & Light and Westinghouse filed with the Atomic Energy Commission under the third invitation of the power demonstration reactor program a proposal directed to construction of a proposed nuclear powerplant and requesting the Atomic Energy Commission to provide certain specified assistance.

Immediately after filing, copies of this proposal were forwarded to the Joint Committee on Atomic Energy.

On February 18, 1958, we were notified that this proposal had been approved by the commission as the basis for contract negotiation. Assistance by AEC will not in any way reduce the commitments of Pennsylvania Power & Light and Westinghouse to the project, but will enhance the financial feasibility of the project by making sponsors' funds available to apply toward payment of the excess costs of the proposed plant.

Scope of Project. Originally, as discussed in some detail in the statement presented last year, the project planned to evaluate two major reactor types:

1. The two-region reactor being developed at ORNL; and

2. A single region reactor to be developed by Pennsylvania Power & Light Co. and Westinghouse Electric Corp. at Pittsburgh.

Each type had its advantages and disadvantages and the final choice between the two could only be made after detailed engineering evaluation of both.

Near the mid-point of the program it was decided to concentrate on the single-region type. This decision was made because of the problems involved in the two-region reactor type with respect to the handling of the heavy thoria slurry needed in its blanket region and with respect to the corrosion of the zirconium core liner.

While we do not consider the single region slurry reactor to necessarily be the utlimate homogeneous reactor, it is in our judgment a reactor that can be built earlier and still show good promise of ultimate economic feasibility.

While limiting our program to the single region reactor type we have continued to maintain very close liaison with ORNL in essentially all phases of our work, and have thereby avoided duplication of technical effort. We feel that the close cooperation and the fine spirit that has existed between the two groups has contributed markedly to the development of the overall technology of homogeneous reactors.

Summary of progress since the section 202 hearings in 1957: The work on the project may be considered as being in two broad fields, development and plant engineering.

By development work is mean experimental and analytical effort to acquire the basic engineering data necessary to implement the final design of the proposed plant.

Plant engineering comprises the problems of nuclear design of the reactor system, development of process flow sheets, and the preliminary design and layout of the plant.

Substantial progress has been made in each of these areas, as outlined in some detail in the full report submitted to you. I will summarize this progress.

A year ago when we appeared before this committee, one major development and test facilities were just coming into operation. During the past year they have been in continuous use.

In addition we have recently placed in operation our new large test loop D. This loop, a photograph of which I have here, and a copy of which is included in the report submitted to you, is a circulating loop made of 10-inch stainless steel pipe having a flow rate of 4,000 gallons per minute with temperatures and pressure conditions as proposed for the actual plant.

By looking at that picture you can see the approximate size, approximately 35 feet wide and close to 40 feet in overall length. It cost us about $600,000 to put it into operation.

This is in sharp contrast to our smaller loops made of 3-inch pipe and having a flow rate of 200 gallons per minute.

We have also markedly increased the size and diversity of our laboratories. We have now invested about $2 million in test facilities and laboratory equipment devoted exclusively to use on this project.

At the outset of our program we considered the handling of the slurry fuel as being the biggest feasibility problem facing us. Today, however, we look at this problem in a much different light. By means of the work in our physical chemistry laboratories we have learned much about the basic handling properties of slurries. We have used this information to successfully circulate slurries at temperatures and pressure in our corrosion test loops for more than 26,000 hours without any serious difficulty.

Twelve thousand of these hours were with slurry fuel of thoria and urania mixtures to which simulated fission products were added to duplicate as closely as possible the fuel that will be used in the reactor plant.

During these test periods we subjected a great many samples of different metals to to the erosive attack of the slurries and are now

able to limit the number of such materials for further investigation to a very small fraction of those investigated to date.

We have on display here results of testing one of these metals under widely varying conditions. You will note that there is no discernible scouring of the metals at the 20-foot-per-second flow speed presently contemplated for the plant.

We show the effect as a function of velocity, all other conditions being kept constant.

You can see at low velocities of the order of 10, 20, 30, 40 feet per second, the corrosive effect is almost zero, certainly adequate for use in the plant which is designed for a flow rate of 20 feet per second.

So we feel we no longer have a serious problem with respect to corrosin and erosion with this particular slurry.

Mr. RAMEY. How about stress corrosion?

Mr. JOHNSON. This is a different problem which I would like to discuss. Stress corrosion is a problem which is not limited to homogeneous reactors, but essentially is a problem which is faced by all reactors which use austenitic stainless steel.

You get stress corrosion providing you have chlorides and oxygen present with the metal at temperature and under stress.

In the many thousands of hours of operation that we have had with our loops, only on our initial test loop, did we have problems which we attributed to stress corrosion and which came from the cleaning process which we used when building the first loop. These showed up within a thousand hours of the time we started operation.

In the later loops we built, we have not had any problems of stress corrosion.

We do feel that this is a serious problem which must be looked at and is being looked at one a very broad front now throughout the country.

We in the PAR project have our own program. The Westinghouse Co. has a companywide program in which we participate.

The National Laboratories also have a very large program.

We certainly feel with as broad a program as is now in effect that during the next 2 years there will be real advances made in the control of stress corrosion.

Chairman DURHAM. Stress corrosion would appear in almost any type of reactor?

Mr. JOHNSON. It will essentially affect any reactor in which austenitic stainless steel is one of the materials. It has nothing particularly to do with the slurry fuels.

The problems of stress corrosion at Oak Ridge National Laboratories occurred in small tubing that were filled with pure water and had nothing to do with the nuclear portion of the plant.

So we feel this is a problem which we cannot duck, but we do not feel that it is limited to our type of reactor or even particularly pointed toward our type of reactor.

We have completed the conceptual design of each major component to be used in the reactor plant. We are now designing and fabricating many prototypes of such equipment to be tested in conjunction with test loop D. These include a main circulating pump, a high temperature and pressure fuel drain tank, 2 types of slurry concentrators, and 3 types of high head slurry makeup pumps.

A concept of how to remotely maintain this plant has been developed in considerable detail and equipment is now being procured to experimentally verify this method. This includes remote welding equipment, special manipulators, tools and fixtures, and full scale mockups of many pieces of equipment.

In the plant engineering area we have completed the second of two major plant studies. The second plant study was started in late 1956 and was based on better design criteria than our earlier studies. Into it was incorporated our best thinking on how to overcome the many problems encountered in the first design.

Conceptual designs of the major components were more definite than those used earlier and as a consequence there was a better basis for obtaining price estimates for this equipment.

The Union Carbide Nuclear Co. developed the conceptual design of the chemical processing plant. This overall plant study was completed in April 1957, and is the basis for our current economic evaluation made for this reactor type.

Status at end of 1957: We feeel we have made substantial progress in many areas. However, some areas remain critical. More knowledge is required before we know where we stand. Important technical problems on which more information is needed include: The effects of radiation on the properties of slurries; the distribution of slurry flow in the reactor vessel; and stress corrosion cracking of austenitic stainless steel.

The practicality of remotely maintaining the reactor plant must be varified by actually carrying out many of the required operations. Additional study must be devoted to the problems of the fuel reprocessing cycle and its integration into the reactor plant.

While we consider that we now have a better basis for estimating capital costs it must be emphasized that the estimates are not firm and we expect that they will be affected by the further information obtained during the 1958–59 research program.

The current cost estimate is $57 million for a 150,000 kilowatt plant. This is based upon a joint estimate with Stone & Webster Engineering Corp. made in mid-1957, and a recent review in the light of knowledge obtained since that time.

The full report submitted to you includes an analysis of the possible cost of power produced by the proposed plant. Based on generally favorable assumptions as to load factor, maintenance, and overall performance, this study shows a power cost, averaged over the assumed 20-year life of the plant, of 9.3 mills per kilowatt hour.

Even so, during the first 5 years, the calculated operating costs of the nuclear plant are estimated to exceed those of a conventional plant by $20 million before allowance for waiver for use charges on fuel and heavy water, valued at $5 million.

Chairman DURHAM. What does that work out per kilowatt installation?

Mr. JOHNSON. $380 per kilowatt.

The initial objective of the project was to determine by early 1958 the technical and economic feasibility of building a large aqueous homogeneous reactor.

Now, after 2½ years, we recognize that although the project has made significant progress certainly it cannot be said that the feasi-

bility of this type of plant has yet been established. The state of the art has not been developed to the point where a prudent decision could be made today to commit the building of a plant either from a technical or an economic viewpoint.

Future research and development: Looking to the future we continue to believe that this type of plant shows good economic promise and that the current program should be continued. We have estimated that 2 additional years of work and a cost of $7 million should be sufficient to obtain the necessary information to permit a prudent decision in undertaking construction of the plant.

However, we believe we should point out that the nature of this development program is such that both substantial difficulties and uncertainties are inherent in it, and changes in this schedule could become necessary.

By the end of 1959, with the completion of this additional 2 years of research and development effort, 4½ years of research work and $12,500,000 will have been expended.

Following this, further research and development will undoubtedly be required in parallel with plant construction. Our present estimate of such additional research and development cost is $15 million, and a further $3 million on research and development during the first 5 years of plant operation.

Thus, the research costs are substantial as are also the indicated capital and operating costs of the proposed plant.

We believe we have made substantial and encouraging progress. While we have encountered some new problems, we have developed a program which should bring about their solutions.

The objective of the project continues to be the building of a large-scale nuclear powerplant of the homogeneous type on the Pennsylvania Power & Light Co. system.

Chairman DURHAM. Thank you very much, Doctor. It looks like you have made considerable progress in basic research.

You would classify it as basic research, would you not?

Mr. JOHNSON. I think we would call part of it basic research and part engineering development.

Chairman DURHAM. Have all of the funds spent so far, the $5½ million, been entirely research and development funds?

Mr. JOHNSON. These have been entirely research and development funds. They do include, however, the cost of the test loop, such as I have shown you the picture of here.

It does not include any funds for buildings and land. This is strictly Westinghouse and Pennsylvania Power & Light money and does not include any Westinghouse facility, as such.

Chairman DURHAM. Is there any other facility in existence such as the loop you built?

Mr. JOHNSON. The small loops we have used and I refer to the 3-inch diameter loops, are close to duplicates to one that exists at the Oak Ridge National Laboratory.

We have, since the first one, built three additional ones of this type and have more facilities of this type than any other laboratory in the country.

Chairman DURHAM. They have done considerable work on this type of reactor at Oak Ridge. Has the information been fully available to you?

Mr. JOHNSON. We have very close working relations between our own laboratory and Oak Ridge National Laboratory.

And you know, we have one joint program with them on in-pile radiation work.

In addition to that we make 2 or 3 trips per month, to Oak Ridge National Laboratory, and their engineers are making about the same number to our laboratory.

Chairman DURHAM. How could you arrive at a cost of 9.3 mills per kilowatt-hour, being no further along than you are at the present time? Have you projected the costs?

Mr. JOHNSON. This analysis has been carried out primarily by the Pennsylvania Power & Light people and I believe Mr. Busby can answer that better than I can.

Mr. BUSBY. Mr. Chairman, we have gone through quite an intensive program of trying to cost this plant to the best of our ability.

Chairman DURHAM. I wondered why you tried to arrive at this at such an early stage. Of course, you still are in the research and development stage.

Mr. BUSBY. This is one way of testing the prudence of continuing with the program. Every 6 months or so, we go through a very careful review of cost, as we project it. Then we try to translate the capital cost and certain operating conditions which we believe can be realized into power costs.

This gives us a judgment figure as to whether or not we are really making progress toward our objective, which is, of course, economic nuclear power.

At the moment 9.3 mills is not economic power, but it is not too far away either, when you are considering this is a first generation plant with all of the difficulties and extra costs that are inherent in that.

So we have been quite encouraged by that cost figure.

Chairman DURHAM. It is about as near as anything we have had in the picture?

Mr. BUSBY. We don't think it is a figure that is picked out of the air by any manner of means, because this phase of the program has been the subject of very intensive consideration right along because, of course, we recognize this is the ultimate proof of desirability.

Representative HOSMER. Is that 9-mill figure with or without waiver of fuel service?

Mr. BUSBY. That is without.

Representative HOSMER. It includes fuel service?

Mr. BUSBY. That is correct.

Mr. RAMEY. I notice on page 2 you say you have a better basis for estimating capital costs. There was some discussion of your basis for estimating capital cost in the hearings last year, as I recall. Would you give an indication of your better basis?

Mr. BUSBY. Yes, Mr. Ramey. I regret that Senator Anderson is not here this morning because we were somewhat embarrassed last year that we did not have more knowledge and analysis of cost. We think we are in a much better position this year.

Last year under some pressing by the Senator we kind of picked a figure of $300 per kilowatt. This was a barebones plant cost. It did not include the cost of an onsite chemical processing plant. It did not

include other costs that you have to recognize, like interest during construction and so on.

Our estimate of $57 million now takes all of these factors of cost into account and we think it includes all of the known elements of cost that we will encounter.

It also includes, I might say, an overall figure of 17 percent for contingency with respect to the nuclear portion of the plant.

Chairman DURHAM. I might say that Senator Anderson has been sick in bed all week. That is the reason he is not here.

Mr. Price?

Representative PRICE. I think that this was to be the critical year as far as your project is concerned; this was the year when you were going to decide whether or not you were going to build the plant.

Have you reached that decision yet?

Mr. BUSBY. You are quite right. When we launched this program in 1955 we were a little more unaware of facts and a little more optimistic and we had hoped, as of 1955, that by the end of 1957 we would be in a position to know what we should know to commit a decision on the plant.

As we have come along in 1956 and 1957, we realized that we were a little optimistic. We are not at that state now. Our conclusion has been, indeed, that it would take 2 more years, 1958 and 1959, and the expenditures of about $7 million as Dr. Johnson has mentioned, to reach the point of prudent decision.

Representative PRICE. You think it will be another year before you are ready to—you said 2 more years, but you also said 1958 and 1959.

Mr. BUSBY. 1958 and 1959. In other words, the current year, plus 1959.

Representative PRICE. So that in another year and a half or more, you will have reached the point where you can determine whether or not it is feasible to go ahead with the construction of a reactor producing electrical energy?

Mr. BUSBY. That is our present thinking but, of course, we are going into an area of some unknowns. This is our best judgment. We cannot guarantee that.

We would like to say that that is a guaranteed date, of course, but it is beyond our power to do so.

Representative PRICE. It will be the end of 1959 before you are ready, then, to make this determination.

When do you estimate that you might have a plant in being?

Mr. BUSBY. December 1963. In other words, a 4-year construction program. We have tested this with Stone & Webster as to feasibility and tested it in terms of our construction experience—we do our own plant construction. We believe this is a date that could be met subject, of course, to all of the unforeseen delays that can affect any construction project.

Representative PRICE. Close to the end of 1963?

Mr. BUSBY. Yes, sir.

Representative PRICE. What do you estimate the final cost of your operation will be by that time?

Mr. BUSBY. The capital cost of the plant under present cost is $57 million.

As I mentioned, there is a contingency factor in there and at the moment we are not putting on top of that any price escalation factor for the reason that as we are going along here we are finding that there are elements of cost reduction as we learn more about this, as well as cost increase, and at the moment our thinking is that with the provision for contingencies that we have made this is as realistic a basis for determining prospective capital costs as we can now make.

Representative PRICE. Will the whole cost be borne by industry itself?

Mr. BUSBY. The proposal we filed with the Atomic Energy Commission—of course, here today we want to answer any questions anybody may have on that—contemplates that the Atomic Energy Commission would only provide research and development assistance and all other costs would be borne by another source.

Now, I would like to make this clear, that this project does involve some unknowns, and as we go along we could find that the costs are very different than we now expect them to be, and if we found them to be very different this could change our outlook on how the costs should be borne.

I want to be perfectly frank about that.

Representative PRICE. There have been statements made that there would be no need for any Federal contribution to this particular project, that the industry itself would bear this cost.

Mr. BUSBY. I certainly think that our original intent, Westinghouse and Pennsylvania Power & Light, when we started this project in 1955, was that we would be able to do it without any factor of Government assistance at all.

Representative PRICE. You publicly stated that, at least the Pennsylvania Power end of it did.

Mr. BUSBY. I think that is right.

Representative PRICE. Now, what would bring about that change? Would it be the obstacles you have run into? What would bring about the change in position?

Mr. BUSBY. It is a matter of financial feasibility. When we started in 1955, Westinghouse and Pennsylvania Power & Light said, "Well, we will put up a certain sum of money and over and above any cost we would incur in building a conventional plant and we will see if expending this amount of money will bring this project home."

We went ahead and spent $5½ million of our own funds, which was a substantial portion of the part we set aside.

Then we took a look at the situation and we could clearly see that continuing to go ahead and spend this special reserve fund, you might say, would not even carry us through the total cost of the research bill that we foresaw ahead.

Further, it would leave us with a capital cost of plant and excess operating costs for plant operation that would result in a very large deficit.

So we concluded that we could make this project feasible if at this point now the further research and development work necessary could be borne by AEC and then all of the funds that we have always been prepared to put into this project over and above conventional power-plant costs would be then put into bearing and offsetting the excess capital cost of this plant and offsetting the excess operating cost.

In that way the project could be made feasible.

But the main difficulty that confronts us is a higher research and development cost, frankly, than we anticipated.

Representative PRICE. Has the Atomic Energy Commission put anything into the project?

Mr. BUSBY. As of today, no.

Representative PRICE. As of today?

Mr. BUSBY. No.

Representative PRICE. Does it appear likely that they may be requested to do so?

Mr. BUSBY. We did file a proposal requesting research and development assistance effective January 1 of this year.

As you know, that has been accepted. It is now before this committee for review and final approval or disapproval.

Representative PRICE. The reason this testimony is interesting is because one of the officials of the Pennsylvania Power & Light Co. testified in opposition to the Gore-Holifield bill that:

> The public utility industry is prepared to do this job and under those circumstances the Government of the United States should not intervene.

Would you not call it intervening if the Atomic Energy Commission were called into the picture with a financial contribution to do much of the research and development?

Mr. BUSBY. Well, I don't know whether I would call it intervening if we were the ones that proposed it. I am sure you are referring to the testimony of Mr. Oakes.

Representative PRICE. That is right.

Mr. BUSBY. I am somewhat familiar with that.

Representative PRICE. What did he mean by intervening?

Mr. BUSBY. I think what we had in mind is that Pennsylvania Power & Light and the industry generally, I am sure, wants to do everything it can to make progress in the development of nuclear power and we want to carry the cost burden to the full extent of our ability to do so.

Representative PRICE. He said they were fully prepared to do that.

Mr. BUSBY. Well, I think we have to perhaps recognize the context of these things, and I know it is true in this project, that as we have gone along we recognize that costs are higher than we thought they would be originally.

Representative PRICE. Does that mean that you people were thinking ahead of Mr. Oakes?

Mr. BUSBY. I think we are dealing now with a very advanced reactor concept.

Representative PRICE. But you are not fully prepared to go ahead now without Government assistance?

Mr. BUSBY. I think that is definitely true. We are asking for research and development assistance and waiver of use charges from AEC.

Chairman DURHAM. Mr. Hosmer?

Representative HOSMER. The brochure mentions problems of keeping the slurry component from settling and another problem of uniform distribution of fuel in the reactor vessel.

Has any approach to that problem been made with the use of the ultrasonic suspension?

Mr. JOHNSON. We initially had a rather large program on ultrasonic suspension of slurry in the drain tank.

The work that we did indicated that the power requirement would be so high that this probably would not be an economic way of doing it and probably the more conventional way of mechanical stirring was a more practical way of doing it.

We have not given up this approach completely, however, and we have the Westinghouse-New Products group looking at it again from the feasibility point of view.

Representative HOSMER. What is the temperature of the slurry in the reactor vessel?

Mr. JOHNSON. The exit temperature is 580° F. The inlet temperature is 465° F.

So we have an average temperature of somewhere in the order of 525 degrees.

Representative HOSMER. What is your pressure?

Mr. JOHNSON. The pressure that we are now designing to is 2,000 pounds per square inch. We probably will lower this some to the order of 1,600 to 1,800 pounds as we get into more detail on the transient analysis of the operational problem.

Representative HOSMER. This slurry goes through a conventional heating chamber?

Mr. JOHNSON. The system is very similar to that which is used for a pressurized water reactor. We have a reactor vessel where the fuel is heated and then circulated through a steam generator which is almost identical to that being planned for the Yankee Reactor, back through a pump to a reactor vessel.

So the mechanical concept of the primary system and the type of components used, with the exception of the reactor vessel itself, are very similar to those that have been, and are being, developed for pressurized water reactors.

The main coolant pump is a pump taken directly from the design of the pressurized water reactor, only the materials of the impeller and the hydraulics have been modified.

Representative HOSMER. You get a good deal faster velocity at the impeller than your chart shows for the rest of the system?

Mr. JOHNSON. That is right. This is perhaps the main point where we have corrosion in the system.

On the pumps which we are using on the smaller loops the velocity is about 80 feet per second at the impeller.

In the pump that we have in loop D, which is close to the prototype of the final plant, the velocity is down to the order of 50 feet per second.

At 50 feet per second we do have some wear, but we believe that it is an acceptable wear rate and all that we would have to do would be to replace the impeller of the pump on a periodic basis of several years.

Representative HOSMER. You mentioned your problem of the separation of the heavy water into its components. Do you still have that problem in this design?

Mr. JOHNSON. Yes; we do have decomposition of the water in the reactor vessel.

One of the problems facing us is either the development of a catalyst that can be used with the slurry for recombination or the

development of an external system for recombining the gases in the plant.

If we can develop a suitable catalyst for internal recombination this could reduce our cost estimate considerably from the $57 million that we now have.

Representative HOSMER. When the recombination occurs do you get the usual heat discharge?

Mr. JOHNSON. Yes.

Representative HOSMER. Where do you plan to take advantage of that in the system?

Mr. JOHNSON. If you have internal recombination the heat is dissipated right within the reactor vessel and you get full utilization of this heat.

If you have external recombination this heat is lost.

In the design that we now have with external recombination we use part of this heat for feed water heating, but we do not recover all of it and that is another good reason why we would like to develop a suitable catalyst for internal recombination of this gas.

Representative HOSMER. If you could do that, would it substantially increase the efficiency of the plant?

Mr. JOHNSON. If we lost all of the heat of recombination, it would be about 5 percent of the heat output or about 1 percent on overall plant efficiency.

We would gain part of this back if we used part of it for feed water heating.

I think the gain that we would get in reduction in capital cost is the big factor for going toward internal recombination.

Representative PRICE. Dr. Johnson, what do you think the advantage of your single region reactor would be to the Oak Ridge double region homogeneous?

Mr. JOHNSON. We use a much lighter slurry, a slurry that has a concentration of about a third to a half of that proposed for use in the blanket region in the two-region reactor.

It turns out that the handling properties of this lighter slurry are very much better than with the heavier slurry. It appears that at about 600 or 700 grams of thoria per kilogram of water, the handling properties change quite markedly.

The second advantage is that we do not have the highly acid core region that is inherent in the two-region design and do not have the zirconium liner that separates the core region from the blanket region.

The problem that Oak Ridge has run into is the corrosion of this liner. There are, on the other hand, real advantages to the two-region reactor with respect to conversion ratio and I am sure that if these problems can be satisfactorily solved, that the two-region reactor on a long term basis is probably a better reactor than what we are now contemplating.

On a shorter term basis, however, we feel that we can build our type of reactor quicker, we obviate some of the problems I have pointed out, and the economics still look acceptable.

Representative PRICE. Do you have a technical problem involving pumps in your single region?

Mr. JOHNSON. I missed the beginning of that.

Representative PRICE. The pumps?

Mr. JOHNSON. The pumps?

Representative PRICE. Yes.

Mr. JOHNSON. The pumps would be quite similar in both plants. Most of the components we are developing for our type of reactor could be used almost without change in the two-region reactor with the exception of the reactor vessel itself.

Representative PRICE. There has been some criticism directed towards the homogeneous reactor because of the possible high maintenance cost.

Do you think that is equally applicable to the single-region and two-region?

Mr. JOHNSON. These costs would be identical for the two reactors. They are both high pressure reactors, they would both have to be completely maintained remotely.

The cost of this maintenance is one of the questions which we now have to get an answer to.

Representative PRICE. Do you agree that that is one of the serious problems involving the homogeneous?

Mr. JOHNSON. This is a serious problem for any liquid fuel reactor.

Representative PRICE. It is more so in the homogeneous than any other. The pressure is so much that there is a greater problem in the homogeneous than almost any other type of reactor?

Mr. JOHNSON. It depends again on whether you are referring to aqueous reactors. The liquid metal fuel reactor is a homogeneous reactor and has exactly the same problem as the aqueous reactor.

So the problem of remote maintenance is a problem which covers a wide variety of reactor types and anything that you can do in developing these techniques for one reactor is almost directly applicable to any of the other reactor types that need remote maintenance.

Representative PRICE. Thank you very much.

Representative HOSMER. Mr. Chairman, I have a question.

Chairman DURHAM. Mr. Hosmer.

Representative HOSMER. In connection with this erosion problem, I presume you are doing everything you can to add lubrication to the slurry. Does that have an effect?

Mr. JOHNSON. You try to do this by preparing the slurry in the proper way. You can change the erosive properties of the slurry, depending on how you prepare it. You have to end up calcining material, and the temperature at which you calcine determines the hardness of the material you are using.

So you really do not have lubrication in the normal sense, but you do have some control over the erosive properties of the material.

Representative HOSMER. Is there any way that has been investigated to repel this as much as possible from the surface of the highest point of erosion, say, electronically?

Mr. JOHNSON. We are not sure what the mechanism of erosion is right now. There is probably electrical repulsion that is taking place at the present time.

We do know that we can change many of the properties of the slurry by the addition of various types of additives which change the electrical charge on the slurry particles.

We have a very intensive program underway on that particular problem.

Representative HOSMER. That is one of the avenues which will give some kind of solution to this problem?

Mr. JOHNSON. Yes.

Representative HOSMER. As I understand your testimony, or Mr. Busby, the anticipated cost of this thing is around $108 million?

Mr. BUSBY. I think that is perhaps lumping together capital costs, research costs, and our estimated excess operating cost during the first 5 years of plant operation.

So that is quite an amalgamation of costs, not all of which are in the same family.

Representative HOSMER. That is the overall cost of the research and development——

Mr. BUSBY. That is the total of all those costs.

I believe that includes research and development. We are talking here of $5½ million we have spent to date. We are talking of $7 million in 1958–59, an additional $18 million in parallel with construction and during the first 5 years of operation.

That is $30 million for research and development; $57 million for capital cost. That is $87 million.

And another $20 million of excess operating costs, which would be reduced however, by $5 million if there is a waiver of fuel and heavy water charges.

Representative HOSMER. You are asking, then, roughly, for $25 million from the commission?

Mr. BUSBY. That is what our proposal provides for, plus waiver of fuel charges and heavy water charges valued at $5 million. That is $30 million in relation to the $108 million that you mentioned.

Representative HOSMER. In other words, whether you did it all yourself or the commission did it itself, it would probably end up costing around $108 million.

Mr. BUSBY. That is true, as we see the figures today for this kind of plant.

Representative HOSMER. If the commission did this job it would cost $108 million out of public money. If you do it, it will cost around $30 million out of public money, instead.

Mr. BUSBY. We believe this is an important justification for this program.

Representative HOSMER. Thank you, Mr. Chairman.

Chairman DURHAM. Your excess costs of $20 million are based on the differential in cost over a conventional type plant.

Mr. BUSBY. During the first 5 years of plant operations, Mr. Durham, we mentioned 9.3 mills was a levelized average annual cost for the nuclear plant.

We compare that with about 8 mills for conventional plant. That is how this excess operating figure is arrived at.

We have come to the conclusion that the worst period of time you have is the first 5 years. After you get by that, you are going to get something that is very much closer to a comparable cost.

Your nuclear plant has a shorter life, your depreciation will have taken effect and thus reduced your capital cost somewhat and you get down to a more livable basis.

Chairman DURHAN. I do not believe anybody has taken into consideration the operating costs over and above conventional power in

their calculations of the overall cost of the plant. I believe you are the first one that has entered this item into the field.

Mr. BUSBY. We thought it was the proper thing to take into account because the dollars have to come from somewhere.

Chairman DURHAM. I think it is.

Mr. Price?

Representative PRICE. I have been thinking about the financial structure you mentioned. With the very nature of the setup of the utility, where profit is limited by control, it does not make much difference where the money comes from. It is the consumers' and taxpayers' money.

Mr. BUSBY. Every nickel that the Pennsylvania Power & Light Co. takes in comes from the customers and I believe that is true of every industrial concern in the United States.

Representative PRICE. Since you are regulated and are under strict control, whatever you spend in this has to be reflected in the rates you assess the consumer?

Mr. BUSBY. I think there is this factor in the situation. The consumer today is benefiting from very great advantages in technology that have occurred over the past years in which companies like Westinghouse have been great leaders and I think our own industry have contributed in some degree to developments which have produced better service at lower cost.

I think each generation of customers is getting benefits of the prior generations advances in research and is paying for research costs that a subsequent generation will benefit from.

This is very true in nuclear power.

Representative PRICE. I do not think very many people oppose Government assistance in this program.

As a matter of fact, we recognize the fact that it is going to be necessary if you are ever going to develop a power program in the atomic energy field. It is just a matter whether we should do it openly and aboveboard. What many people do not like are hidden subsidies. As long as they are out in the open and aboveboard, I think you will find little opposition to them.

Mr. BUSBY. Certainly, Mr. Price, we are not trying to hide anything.

I would say this: I think there is quite a difference between a program under which the Government imposes a program of nuclear powerplant construction and sale of power to the detriment of our industry and a program which permits our industry to participate in the development of nuclear power.

Representative PRICE. We have never had such a proposal before the Congress in any form that I know of.

Mr. BUSBY. I am sorry I did not catch that.

Representative PRICE. We never have had such a proposal as that.

Mr. BUSBY. The viewpoint that we have taken on it is that basically the fuel situation in the United States does not require emergency development of nuclear power here, but that there are other considerations, foreign considerations that may do so.

That is a proper basis for some Government participation, therefore, in the development of nuclear power now.

Representative PRICE. I think the proposal that many people mistakenly opposed was to build Government-supported demonstration

plants to get them in operation as quickly as possible so that they would be available to American industry, utilities and equipment people as quickly as possible.

You say, yourself, that there is no possibility of getting your plant in operation before 1963. Many of them think 1964, because you say at the end of 1963. Many of us have thought the Government should get the thing going a litle bit faster.

The only proposal I have ever seen presented to Congress is one to accelerate this program in the interest of all American business.

Mr. BUSBY. We certainly think that a program which is properly geared to the national need and provides for acceleration and does not certainly injure any part of the American industrial community would be a desirable one.

Representative PRICE. It would not injure it and it would certainly be a great benefit to it and it probably could be accomplished at great savings to the taxpayers and to the consumers of the Nation.

Mr. BUSBY. We have not defined a program, so perhaps we are not at any different point of view.

Representative PRICE. We attempted to define such a program. Many people who just did not think it through too clearly opposed the program.

Mr. BUSBY. As a company, we are certainly very much concerned about the implications of the preference clause tied in with a Government powerplant program.

There is no doubt about that. You do know that, of course, from many discussions.

Representative PRICE. There has never been any suggestion in the atomic energy field that a preference clause be tied in with that. The people interested in the acceleration of this program have done everything possible to avoid that issue being involved.

The only ones that ever bothered to involve this are the people opposed to the accelerated program.

Mr. BUSBY. My own personal concern has been that a program would develop that would actually have the effect of taking sides as between public power and private power.

Now, I think that it would be most desirable if a program could be worked out which would not have that effect.

Representtative PRICE. Of course, I think such a program was worked out. I think it was mistakenly opposed by people who say that they favor an accelerated program. We took every possible step to make certain that whatever demonstration plants were built were built on Government installations not in competition with any existing power company. We did everything that we could to keep that question out of the effort to accelerate this program.

The only people who put it in were those who were opposed to the accelerated program, who are throwing it out as a way of developing opposition to the program.

Mr. BUSBY. We would not have started our program and spent $5½ million and been prepared to spend more if we were not in favor of the prompt development of nuclear power, Mr. Price.

Chairman DURHAM. Thank you very much, Mr. Busby and Mr. Johnson.

Mr. BUSBY. Thank you, sir.

Chairman DURHAM. Without objection the report will be placed in the record by reference.

Mr. BUSBY. We appreciate the opportunity to appear before your committee, sir.

Chariman DURHAM. Thank you very much.

The next witness is Daniel Kimball, president of the Aerojet General Corp.

We are glad to have you here this morning, Mr. Kimball.

STATEMENT OF DAN A. KIMBALL, PRESIDENT, AEROJET GENERAL CORP.

Mr. KIMBALL. I have a short statement I would like to read to you and discuss it briefly.

Chairman DURHAM. All right, sir, you may proceed.

Mr. KIMBALL. Mr. Chairman and members of the committee, I appreciate very much your invitation to appear before you. I have observed the work of this committee for a long time, and I think you have had a great and beneficial influence on our progress in nucleonics.

My testimony today will concern three aspects of nuclear research and nuclear weapons production; first, the security regulations of the Atomic Energy Commission as they apply to contractors; second, patents on nuclear inventions; and third, the place of industry in the production of nuclear weapons.

The Aerojet-General Corp. has many classified contracts with the military services that are under Department of Defense security regulations. It has other contracts that are under AEC security rules, and we have had at least 1 project where the 2 systems of security overlapped.

In the latter instance we found that dual systems of security control led to confusion. There were times when men doing similar work under Atomic Energy Commission and Air Force contracts could not discuss identical documents because they had received them from different sources. That was on a matter of great importance to the defense of the United States.

I am glad to be able to say that procedures have been established to expedite correction of a situation like that.

However, the fact remains that a man with Atomic Energy Commission clearance for one job does not have clearance for another. Under Department of Defense rules, a man cleared for secret classification may be given, if the contractor determines a need for it, secret information on matters other than those on which he was working when given clearance.

In my opinion, compartmentation of knowledge has cost the United States much priceless time. For example, with respect to the storage of classified material, the Atomic Energy Commission attaches the same level of important to confidential-restricted data that the Department of Defense attaches to top secret.

The higher level of security precedures demanded by the Commission was promulgated when this country alone was believed to have the atom bomb. That reason certainly is not valid today, as I see it.

I do not object to strict rules, strictly enforced. But I think no security would be comprised were one set of regulations established

for both the Atomic Energy Commission and the Department of Defense.

I recommend that to increase the tempo of the defense program, this committee take what steps are necessary to bring about the conformity in the security measures of the Commission and the Department.

In the area of patents, also, private industry receives different treatment from the Atomic Energy Commission than from other Government agencies.

Under the Atomic Energy Act of 1954, if anyone with any kind of relationship with the Atomic Energy Commission makes an invention pertaining to atomic energy, that invention is deemed to have been made by the Commission.

That's true whether it cost the Government a cent or not. Therefore, the Atomic Energy Commission may preempt any patent. Should the Commission exercise its right, it may license any American to utilize the invention.

To me this appears a way to stop industrial research in nucleonics. If research results in invention, those who conduct research at their own cost have no more rights in their work than those who have spent nothing.

When work done under Government contract has patentable results, they should be licensed free to the Government, of course. That is done in nonnuclear fields. For example, Department of Defense contracts protect the Government fully. But they also protect the inventor against infringement for commercial purposes, which is the basis on which American industry was built. That provides industry with incentive to work in new fields.

Besides having automatic preemption rights to patents for most inventions not made under specific contract, the Atomic Energy Commission goes further in its contracts. The Commission's manual provides for three types of patent clauses, A, B, and C. In practice, the clause almost invariably included is type A, which takes all title and goes far beyond protecting the interest of the Government.

Under that clause the right to apply for all domestic and foreign patents belongs to the Commission, and a contractor must even apply to the Atomic Energy Commission for a license to use what he has invented. Any American citizen can make a similar application and almost automatically acquire a license to use the invention.

The right of the Atomic Energy Commission to apply for foreign patents has been exercised at Government cost for the expenses of filing and for foreign taxes. Industry might make use of foreign patents, but I do not see their value to the Commission. The United States never has sued anyone for infringement, so why need it own patents?

Besides that, the Atomic Energy Commission does not file as many foreign applications as it is possible to file, American citizens aren't allowed to file but foreign citizens are, and the fruits of American ingenuity are being lost as a consequence. Of equal importance is the fact that industry is being deterred from entering this field.

With a view to encouraging rather than discouraging advances in the nuclear field, I urge that the act be amended to provide full protection for the Government, but to give some protection to industry as well. This can be done by allowing contractors to own patents on nuclear inventions, subject to license to the Government.

This brings me to the subject of how much industrial participation there should be in the development and production of atomic weapons.

The Atomic Energy Commission has followed a practice of developing nuclear weapons in its own facilities. In the light of American history whether that method assures us the best weapons possible seems open to question.

For generations the Army and Navy made most of their own weapons, except in time of war. In consequence, each war has found American industry unprepared to support the military immediately.

The wars have lasted longer than they need have, and been vastly expensive in men and in money, because industry was not able sooner to give our forces what it took to win.

It is fair to say that Government arsenals are not always the places where technical advance is most rapid. Sometimes we have been critically handicapped during years of war because Government plants have not developed successful weapons. American torpedoes of World War II are an example.

The nuclear weapons of the United States are designed chiefly at Livermore and Sandia. Whether they are the best that could be made, or nearly so, nobody knows, because nobody else has had an opportunity to try to improve them.

Considering the variety and size of the industrial organizations now capable of working on design and development of such weapons, I regard the present system as less than the wisest.

Into the development of very complex devices goes one factor more important than any other. That is an intuitive feeling for what is right, something that comes only from experience and familiarity with similar problems.

Industry is making the vehicles to deliver atomic warheads. In that area there cannot be too close an association between the men who design the warhead and those who design the delivery system.

In nonnuclear systems that close relationship makes the work of each group better, and we need in every way we can to try for the best in nuclear weapons.

If we are to develop the most effective weapons systems possible, the systems designers should have a hand in the design of the weapon itself, especially as relates to ruggedness, safety, readiness for manufacture, and suitability for field use. That means testing by the manufacturer, as well.

Production engineering certainly should be carried out by those who will be called upon to produce nuclear weapons in large numbers if they are needed quickly.

To provide in the nuclear field against the timelag that has been a feature of the arsenal concept of producing weapons, I recommend that the Congress direct the Atomic Energy Commission to put a much wider industrial base under its weapons programs. That work should be spread now to the industries that obviously will be asked to participate in it at a time of crisis.

Mr. Chairman and gentlemen, I want to thank you again for inviting me to testify, and I will be very happy to answer any questions you may have.

Chairman DURHAM. Mr. Kimball, you present a very thoughtful and provoking problem. There have been many people thinking about this problem and this type of procedure.

I guess we got into this socialized structure of developing this weapon because of the very nature of the beginning of it.

It has been very difficult to get out of it. It is a little different picture from the average weapon, do you not admit that?

Mr. KIMBALL. Mr. Chairman, it was at the start because the knowledge had to be held in the Government and we hoped that no other government would get this knowledge. However, since it now seems that it is not the exclusive property of the United States, it might be well to see if this work could be spread to other people.

I think industrial organizations could possibly improve on the warhead. I have no means of knowing that because we are not allowed to see it.

Chairman DURHAM. I think I agree with you on that part.

It has been historically in the development of all types of weapons from the beginning time that American industry has done a good job on all of the different types of weapons, at a faster pace and probably more efficient than the Government and at less cost.

But as we stand today, do you feel it would be a wise recommendation for the Congress to close the laboratories and say to industry, "Here, take this job and go out and do it"?

Mr. KIMBALL. No, sir; I don't think you can close very quickly the laboratories you have. They have done some fine work.

I do say over a period of years industry should be phased into this work gradually and evaluate it to see if they can do it better.

Chairman DURHAM. That was the intent of Congress in adopting the 1954 act. Our effort then was to get this whole business out into private enterprise in the long run. They have done a pretty good job so far at least of getting some of it out.

I think it is still overclassified, I agree with you on that. I think that is one of the problems that we face.

Mr. KIMBALL. Under war stress, Mr. Chairman, you have the best talent in the world in those industries. As the business goes along for a number of years much of that talent will tend to leave to get into other fields or nuclear field outside of the Government.

We have some of those people now. It seems that with the engineering knowledge and production knowledge that companies will have, I recommend that it be looked into to see if they can be phased into important parts of this work.

I don't think it can be done quickly, but I think it should be looked at over a long period of time and some advance made in it.

Chairman DURHAM. You were connected with the Defense Department here for quite a long time. You know what the problem is. You see the private-enterprise picture.

Mr. KIMBALL. It is very difficult to close a Government arsenal; I know that.

Chairman DURHAM. I see no reason in the world why a man should not, if he has spent all of his funds on a project, he should not be allowed a patent on it. That is part of incentive in development. I cannot see why that should not be done.

Mr. Price?

Where it is done for fun, I think it is a different problem.

Representative PRICE. Mr. Kimball, do you know any concrete instances or can you cite any concrete examples where the Atomic

Energy Commission has preempted patents from organizations that have developed them entirely with their own funds?

Mr. KIMBALL. I do not have any examples with me at the present time, Mr. Price. I think I can find them for you and I will be glad to send them to you.

Representative PRICE. You know the Commission has authority to waive in such instances. If there are examples to support your statement here, I would like to have them.

Mr. KIMBALL. Conformity with the kind of patent regulations that the Defense Department has which protect the Government pretty well, would simplify the work a lot.

Chairman DURHAM. I do not see why some man cannot have one type of information and cannot talk to another individual about a type of information that is of concern to the War Department or Atomic Commission, either. That does not make good business sense.

Mr. KIMBALL. You get some peculiar things in security. For instance, here is the front page of exactly the same report. We got a fund report from the Atomic Energy Commission and one from the Air Force. Anyone with a secret clearance from the military cannot look at the report we got from the Atomic Energy Commission.

Representative PRICE. They are identical reports?

Mr. KIMBALL. They are.

Chairman DURHAM. That does not make sense.

Mr. KIMBALL. Those are the things that give you a little trouble now and then. That is one reason why some of these security regulations can be cleared up and still provide adequate security.

Representative PRICE. If a contractor that has just completed work on one AEC contract and the company seeks to move into another project, does the employee require further clearance before he can move to the new project?

Mr. KIMBALL. Yes, sir. You get a clearance from the Atomic Energy Commission for a man to work on one project. You cannot put him on some other project without specific clearance.

Representative PRICE. Even though he has the top priority clearance?

Mr. KIMBALL. We have to get permission to move him from one to the other.

Representative PRICE. I might see where you might need permission. Is it merely a matter of getting permission to move him, or do you have to go through the whole process of clearing him?

Mr. KIMBALL. You don't have to clear him again.

Representative PRICE. I can see where you might require permission because you would want to know the personnel working on the various projects, otherwise you would have a pretty loose security system.

Mr. KIMBALL. On the Defense Department contracts if a man is cleared for secret, has a need-to-know, and can construct something, we can move him into a project without any trouble.

Representative PRICE. There are different grades of security clearance. I can see where it would be possible that a man might be included for some type of secret information, but not complete Q clearance.

Mr. KIMBALL. If he is cleared for secret the contractor can make a determination whether he should move him to another project without asking anybody. We can make that determination ourselves.

Representative PRICE. Well, that is something to look into, although I can see some reason for the necessity of coordination of such a move so that everyone would know who is entitled to work on the project and who was not.

Mr. KIMBALL. My only reason for bringing it up is that in the day to day——

Representative PRICE. I think that you do a service in bringing it up. It is something for us to look into to determine whether it is a sound policy, particularly this interservice clearance, I think there should be some coordination in that.

I think you do a service by bringing it up. It is a problem for the committee to check into to see if it is a sound policy matter.

Does Aerojet have access to information on the controlled thermonuclear program?

Mr. KIMBALL. No, sir.

Representative PRICE. Have you ever sought it?

Mr. KIMBALL. We have some people who have worked on it, but we have done no work on the thermonuclear program.

Representative PRICE. You have never sought access to information on it?

Mr. KIMBALL. No. On certain projects we will have, for instance, on the Rover project, which is nuclear rocket, we don't do any of the nuclear work, we don't have access to it.

We make the hardware that goes with it.

Representative PRICE. Thank you very much.

Chairman DURHAM. Mr. Hosmer?

Representative HOSMER. I am glad to see you again, Mr. Kimball.

In connection with your recommendation that industry get into the weapons-manufacturing business, you did not go into any details with respect to the security problem.

I am wondering if that is not a more or less insurmountable one because you talk of the variety and size of industrial organizations that could get into this. If you spread this out all over the country, you have an almost insurmountable problem, do you not?

Mr. KIMBALL. I don't believe so, for this reason: All our work in Aerojet is done under security regulations with the Defense Department. Most companies that do work for the military have some very strict security regulations that they abide by. So the security problem, it does not seem to me, is any great problem, because your people are very carefully cleared.

Anybody that is cleared in our plant for secret has to be a fairly substantial citizen.

Representative HOSMER. Every time you bring in a person who is cleared, you bring in a potential risk. I do not mean that he is, but it is one more place from which a leak could be made, and when you transfer operations to new factories or organizations, that enlarges the whole plant security problem. It seems to me that we would get into a pretty large field here if we followed your suggestion.

Mr. KIMBALL. If nobody else had the atomic knowledge, I think that would be true, but I do not think we have any corner at the moment.

Maybe we are kidding ourselves a little bit about this security.

Representative HOSMER. There may be parts of them they have that we do not have and vice versa.

Mr. KIMBALL. Some of the things we put under security looks ridiculous. We have very tight files and then we read about them in the newspapers next morning.

I think security does two things: It costs money and it costs us much time because to abide by the security rules which you have to do is a time-consuming operation.

At our plant in Sacramento, we have to have a guard force, that is 75 percent as large as the Sacramento police force.

Representative HOSMER. The only other think about it in that connection is the fact that there are weapons today in the megaton range that I do not know how much more improvement is, either from a national defense standpoint or a moral standpoint, desirable on that capacity of weapon.

Mr. KIMBALL. I think most companies handle security pretty well because they want to hold their proprietary knowledge and I think they do it pretty well.

Representative HOSMER. I do have a question in respect to your patent suggestion. I wonter if Aerojet General has been discouraged in making any endeavors on account of the present patent provision.

Mr. KIMBALL. We don't discourage easily if we think something has to be done. These are some of the roadblocks we ran into. We thought we would like to bring them up as a matter of record.

We go ahead and do the things we need to do. If we have something that we don't like, we take an opportunity like this to holler about them.

Representative HOSMER. I guess you are doing all right. I saw the Wall Street Journal this morning; you are making a 10 to 1 stock split.

Mr. KIMBALL. We are doing the best we can.

Chairman DURHAM. Thank you very much, Mr. Kimball. We are glad to have had you.

Mr. KIMBALL. Thank you, Mr. Chairman.

Chairman DURHAM. The next witness is Mr. Biemiller, a former colleague of ours.

We are glad to have you with us, sir. Will you come around, Mr. Biemiller.

STATEMENT OF ANDREW J. BIEMILLER, DIRECTOR, DEPARTMENT OF LEGISLATION, AFL–CIO

Mr. BIEMILLER. Thank you, Mr. Chairman.

Chairman DURHAM. You may proceed with your statement, sir.

Mr. BIEMILLER. Mr. Chairman, I am very glad to be here.

Mr. Chairman, my name is Andrew J. Biemiller. I am director of the legislative department of the American Federation of Labor and Congress of Industrial Organizations. I am also chairman of the AFL–CIO's staff committee on atomic energy.

I am accompanied by Seymour Brandwein, the secretary of our staff committee on atomic energy, and John Curran, an AFL–CIO legislative representative.

I am pleased to appear on behalf of the AFL–CIO to give our views on certain aspects of atomic development during the past year.

The American labor movement is very much interested in our Nation's atomic program, not only as workers handling hazardous atomic materials, but as consumers and as taxpayers with a huge financial investment in atomic development, and as responsible citizens anxious to see our Nation and the world gain rapidly the many benefits available from constructive uses of the atom.

These comments will be brief, concentrating on only several aspects of the atomic program. I would also like to submit for the record as part of this statement a copy of the policy resolution on atomic energy development adopted at the conference of the AFL–CIO less than 3 months ago, in December 1957.

I regret to say that our comments necessarily must largely repeat the observations we made last year and earlier, for the weaknesses apparent then, particularly in the power development program, are still present and are even more disturbing today. Let me emphasize several major points:

First, America's rate of atomic power development is still highly inadequate. The Government should undertake promptly to construct and operate several large-scale atomic powerplants to gain the practical experience and knowledge necessary for the United States to be able to provide effective world leadership in this field and to provide needed impetus for development for domestic needs as well.

Secondly, we believe the past year offers cause for increased concern about the hazards of radiation to workers and to the general public, for there has been an increased tendency to minimize or disregard the very real dangers which go hand in hand with our atomic growth. The year has also seen disturbingly little progress toward needed improvement of workmen's compensation legislation to meet radiation hazards.

And thirdly, there continues to be a real need for a more effective means of considering certain specialized labor-management matters, a need which we believe can be met through establishment of a statutory labor-management committee to work with the Atomic Energy Commission.

Let me discuss each of these points in a bit greater detail.

Atomic power development: On the question of atomic power development, the AFL–CIO has been disturbed that the rate of practical progress has fallen far short of what the United States should and could have achieved.

Although we apparently have been making good headway on research and technical development, our forward movement on practical application has been at only a plodding pace, considering the efforts this country could readily have undertaken.

Other countries with lesser resources have meanwhile pushed ahead and are demonstrating that a forceful program can make great strides in a short time.

The United States, however, simply has not moved with an adequate sense of urgency on the task of actually constructing and operating large-scale power reactors. Without large-scale construction and operation, we lack the practical economic and technical experience needed for rapid progress at home and effective aid abroad.

The Atomic Energy Commission has invariably insisted that the initiative for construction of atomic plants must come from private enterprise—and that the Government should not act on its own. We believe that private initiative is important and should be encouraged, but not to the point where the Government abandons responsibility to provide leadership and necessary initiative.

It is now evident that predictions of growth of atomic plants by 1960, which were based on the assumption that private industry would push ahead on construction, will not be achieved or even approached. Cost uncertainties and technical problems have produced slowdowns and cutbacks in announced plans and abandonment of potential projects.

It is clear, as private industry has now come to acknowledge publicly, that in the face of financial and technical problems private efforts alone will produce a very slow rate of progress, slower than in a number of other countries, slower than that required by our international leadership responsibilities and slower, indeed, than the rate desirable even for our long-term domestic needs.

This is why the Government itself must move ahead to construct several major atomic plants. Nor can we afford any delay in such Government action, for decisions today will determine how effectively we can apply atomic power several years from now. If we proceed quickly, we can still lead the world in atomic development and in significantly hastening the day when atomic power will be a valuable and widespread reality.

The objective of the Government construction program should be to put into practical operation as early as possible several types of large-scale atomic plants which can meet needs abroad and can be competitive in the higher-power-cost regions of our own country.

This should not detract from the longer-run goal of developing through additional research other more efficient types of reactors which could provide even lower cost atomic power which would be economically desirable throughout this country.

The Government program should not be a mere token effort. There is a real danger that the same factors which prevented such a program in the past could trim down to meaningless size and impact any program of direct Government action in the future.

An even more serious danger is that the Government's responsibility may be limited to providing the money for industry to proceed with construction on some so-called partnership basis.

The Government must do more than lay the financial groundwork for making atomic investment profitable for private industry. It must do more than merely fill the financial vacuum caused by private industry's inability or refusal to provide the necessary financing.

It must see to it that the people get their money's worth from their Government's expenditures. It must make certain that the expenditures are made in the general interest and not merely to enrich a limited number or a particular firm.

This can best be achieved in this field through direct Government action and responsibility, with private industry contributing through service as contractors carrying forward the actual work.

In many instances, of course, the Government will and should continue to extend financial aid, primarily through research and de-

velopment assistance, to private firms in atomic power development activities.

Here the public interest requires that, if the Government is to bear a substantial part of the costs, it should see to it that the projects involved are properly administered and that the technical and scientific advances they produce remain in the public domain.

In this connection, it is extremely important to extend the atomic energy law's patent provision (sec. 153), which provides the authority for the Government to require the cross-licensing of privately owned patents when needed in the public interest.

This provision, now scheduled to expire in September 1959, should not be permitted to die. It is particularly important to recognize, not only that chances are still good for a domination patent to be filed after 1959 in the atomic fission field, but most certainly also in the relatively new and vast thermonuclear field.

We urge that this basic public protection be extended indefinitely at this session of Congress. The enacting of such extension this year would make clear, well in advance, to companies which may be holding up on patent development and announcement until after the mid-1959 scot-free date that they do not stand to gain from such deferral of technical progress.

Hazards of radiation: There is a general awareness of the fact that the uses of atomic energy are accompanied by hazards of radiation to the workers involved and to the general public. But we fear that there may be lessened concern over these hazards because of the apparently good safety record to date and because of pressures for economy which may lead to skimping on safety control measures.

We are looking forward to later hearings of the committee on radiation hazards and on workmen's compensation to present our views in greater detail. But I do wish to stress briefly several points at this time.

The first is the important fact that public and worker confidence in our atomic program rests largely on the ability to control and assure safety. If the radiation accident rate were suddenly to increase, or if it were discovered that the small radiation doses many workers have absorbed with no apparent immediate effect actually have long-run adverse effects, or if several dramatic radiation incidents were to occur, many workers and a great part of the public would lose confidence in the wisdom and safety of atomic uses.

Such a loss of confidence could seriously disrupt and hamper atomic progress. The need for effective safety controls is constantly required, not merely for the sake of workers and citizens who may be directly endangered, but for the very success of the atomic program in general.

You will recall the incidents in the city of Houston last year in which some radioactive material was accidentally released. A telecast on the Columbia Broadcasting System last Sunday night, presenting the families directly affected, reviewed how the contamination of several workers and their possessions in the Houston situation touched off near panic among their neighbors.

The program, appropriately titled "Enter With Caution—The Atomic Age," well illustrated the potential frightening effects on the public of even a relatively minor radiation accident—and thereby underscored the importance of strict observance and enforcement of safety standards.

On another point, we have not had an opportunity to check in detail, but we are surprised to discover that the Soviet Union, despite its obvious desire for speedy atomic development, has apparently established some tighter safety limits than the United States has.

The Soviets apparently have established a slightly more restrictive maximum radiation exposure limit and they provide for shorter hours (6 or 5 a day with a full normal day's pay) and longer paid vacations (24 days or 30 days a year) for workers in atomic activities. We suggest that it might be helpful if the committee could explore this more fully.

The increasing signs of an effort to turn over to the States the Federal program controlling the hazards of radioisotope uses are also disturbing.

Several States have shown a constructive interest in a radiation-control program and have regulated to some extent X-ray and other radiation hazards not controlled by the AEC. Perhaps these few States could, at least in their initial enthusiasm, maintain reasonable controls if the AEC relinquished its responsibility, but the bulk of the States are neither adequately interested nor equipped to do the job.

Any program to cut back on Federal responsibility for safety in this area and to cede the job to the States would be a serious disservice to the safety of American workers. We emphatically oppose any such backtracking in this vital health and safety area.

The States have amply demonstrated their unconcern with radiation hazards by their record in a related field. With few exceptions, the States have failed to revise their workmen's compensation legislation to take account of the special problems and needs posed by the peculiar nature of radiation injury.

Some of the State laws do not offer any protection to workers against radiation-induced disability and virtually all fall short of reasonable protection in one or more significant respects.

We are convinced that the need for adequate compensation protection in this unique field can be met only through Federal action. Later in this session of Congress we hope to have the opportunity to explain this need fully.

Labor-Management Committee: Finally, we wish to urge the committee to examine anew a proposal we have advanced for some years, the establishment of a statutory Labor-Management Advisory Committee to the Atomic Energy Commission.

The atomic industry presents a host of peculiar and complex problems of special labor-management concern. These include particularly the health and safety matter, the personnel difficulties still arising out of security regulations, the collective bargaining procedures which need special adapting to the defense-related character of most atomic installations, and the special manpower and training problems.

The presence of continuing expert groups, drawn from the ranks of both management and labor, would serve helpfully to develop and maintain solutions more satisfactory to both management and labor than has often been the case to date.

Mr. Chairman, we appreciate the opportunity to meet with the committee. We will be glad to supplement our comments on any point in

this brief statement. And we trust we will be able to join in the committee's examination of specific problems later in the year.

Chairman DURHAM. Thank you very much, Mr. Biemiller.

Do you desire this resolution to be included in the record?

Mr. BIEMILLER. Yes, sir.

Chairman DURHAM. Without objection, it may be included in the record.

(The resolution referred to follows:)

RESOLUTION NO. 147, ATOMIC ENERGY ADOPTED AT SECOND CONSTITUTIONAL CONVENTION OF THE AMERICAN FEDERATION OF LABOR AND CONGRESS OF INDUSTRIAL ORGANIZATIONS, DECEMBER 1957

The peaceful use of atomic energy has caught the imagination of the world. The atom stands as a symbol of a brighter future. The AFL–CIO believes that America must strive to transform that symbol into meaningful reality by extending vigorous leadership and aid in accelerating constructive use of atomic energy around the world.

Already many nations have demonstrated their need and eagerness for beneficial atomic uses by undertaking ambitious programs to develop peaceful atomic energy despite limited resources. The prime goal has been development of electric power, although valuable industrial, agricultural, and medical uses are also being sought.

Thus Great Britain has already put into effect the world's first large-scale generation of electric power from atomic fuel. Six western European nations have established a cooperative atomic power effort, the Euratom program. On a worldwide basis, the International Atomic Energy Agency has been set up by some 80 countries to hasten and spread peaceful atomic benefits.

Russia has not dawdled on the atomic front. It has pushed ahead on major atomic power projects and it has well recognized the world significance of peaceful atomic development by aiding its satellites and offering atomic aid to other countries willing to turn to it.

The United States led the way to development of the atomic bomb and at the end of World War II it led the world in atomic technology. It has since let its leadership fade. It has failed to do all it could or should to provide leadership to the free world in the practical peaceful applications of atomic energy.

Beginning with the passage of the 1954 amendments to the Atomic Energy Act, the United States Government has depended primarily on the hope and expectation that private industry in this country would more completely develop the atomic reactors and technology necessary for widespread application of atomic energy to the production of power and other peaceful uses—even though the cost and technical problems are so great and the prospect of immediate financial returns so meager that it is unreasonable and unrealistic to expect private industry to carry forward an adequate program.

The result has been inadequate progress, particularly in the construction of full-scale demonstration power reactors. Without such full-scale reactors, we cannot adequately gain the economic and technical information and experience we must have in order to be able to furnish maximum practical assistance abroad and to achieve more rapid progress toward lower cost power at home.

The Federal Government must initiate a vigorous program of atomic development and world leadership in peaceful applications of the atom. It should make the providing of effective peaceful atomic aid to other nations a national objective of high priority. It must demonstrate that we can apply atomic energy as effectively for the benefit of mankind as we have in developing atomic weapons that can destroy mankind.

Such a program requires that the Federal Government undertake promptly to construct and operate a variety of full-scale atomic powerplants in the United States for demonstration purposes. It is not enough to give financial aid to private enterprise to get it to undertake some of this task. Indeed, there are signs that the financial aid already extended may be so large as to make a mockery of the phrase "private enterprise."

It must also be kept in mind that if the Government is to foot a substantial part of the costs, it must assume responsibility for seeing that the projects involved are properly administered and that all resulting technical and scientific developments remain in the public domain.

The spread of atomic uses is unfortunately accompanied by the threat of radiation hazards to worker and public health and safety. Radiation hazards are too serious to permit questionable safety standards or lax or haphazard application of regulatory measures. Apart from concern for the welfare of individuals involved, the occurrence of major radiation accidents could quickly disrupt atomic development by causing a general loss of confidence in and opposition to peaceful uses of atomic energy.

It is important, therefore, that the Congress review periodically the existing machinery for protection against radiation hazards and take steps to increase the effectiveness of that protection. The Congress should also examine the advisability of permitting the Atomic Energy Commission to regulate the industry which it has the obligation to promote. The need for such examination has been shown in the hearing held on demand of several AFL–CIO unions, concerning the safety aspects of the Detroit Edison Monroe reactor project, in which the AEC authorized construction of a dangerous type of reactor in a densely populated area in Michigan.

The Atomic Energy Act imposes on the AEC the responsibility for protecting health and safety in this field. The current effort of the AEC to shift to the States part of its responsibility must be resisted. This effort has been aided by the Council of State Governments, which has recommended that major segments of this responsibility be relinquished to the States. The States do not have adequate staffs or funds to assume these functions.

Even present State functions, such as workmen's compensation and medical care for injured workers, have not kept pace with the risks of this new industry. The States have shown little disposition to modernize compensation legislation to take account of the special nature of radiation effects. Some State compensation laws do not clearly cover radiation injury, others do not allow for delayed effects of radiation, and others are inadequate in still other respects. Amendments on radiation coverage have been enacted in some States, but still have gone only part way toward providing adequate coverage.

The AFL–CIO is convinced that adequate workmen's compensation protection for all workers exposed to radiation hazards can be assured only through enactment of Federal legislation in this field: Therefore, be it

Resolved, That the AFL–CIO dedicates its efforts to gain development of peaceful uses of atomic energy as rapidly, fully, equitably and safely as possible, so that the atom's promise may more quickly be realized in improved standards of living around the world. To this end, we urge that:

The United States should provide effective leadership and aid in international activities to promote peaceful use of the atom. This should include: (*a*) Full support of efforts of the new International Atomic Energy Agency to aid and share atomic progress for the benefit of the peoples of the world; (*b*) encouragement and assistance to appropriate regional organizations such as Euratom which make it possible for a number of countries in a particular region to pool resources to develop a common program in the general benefit; and (*c*) direct United States aid to individual countries.

The AFL–CIO endorses the proposal of the International Confederation of Free Trade Unions to establish a liaison office with the International Atomic Energy Agency.

The United States Government must undertake promptly to construct and operate full-scale, demonstration atomic power reactors.

The Federal Government must also be vigilant to the end that atomic development proceeds in the public interest and Federal licensing standards must be established and maintained for this purpose. While encouraging broader participation by private industry in atomic activities, the public must be given full protection against the development of private monopoly in any aspect of this industry.

The public's interest also requires that full information be provided on peaceful atomic programs. Restrictions on the publication of nonmilitary atomic information should be eliminated.

The program of Federal Government radiation hazard controls must be maintained and strengthened. It must not be weakened through any shifting of responsibility for radiation safety to the States. Problems related to radiation hazards should be reviewed by the most competent medical and public health bodies and the Congress should establish a National Institute of Radiological Health.

At the international level, full support should be given to the development of sound international radiation-control measures through the International Atomic

Energy Agency working in cooperation with the International Labor Organization, World Health Organization, and other appropriate United Nations agencies. The AFL–CIO also endorses studies of the effects of atomic radiation under the auspices of the General Assembly of the United Nations.

The Federal Government should enact legislation to provide uniform adequate workmen's compensation for injuries resulting from radiation exposure.

The AFL–CIO shall also work for the following objectives:

(*a*) As peaceful uses of atomic energy expand, appropriate public and private policies should be developed to meet and ease any adverse effects on workers and their industries or communities.

(*b*) Affiliated unions should cooperate in voluntary manpower, training and educational programs required to meet the atomic age's needs for competent skilled labor.

(*c*) A statutory Labor-Management Advisory Committee should be established to advise the Atomic Energy Commission in developing a sound program on matters of particular labor-management concern.

Chairman DURHAM. Mr. Price.

Representative PRICE. Mr. Biemiller, I notice great attention is given in your statement to the matter of adequate compensation protection to workers in this field. You, of course, know the interest of many of us on the committee in that problem. You and I had discussions on this matter last year.

I know you will be pleased to know that that matter is on the agenda of the Research and Development Subcommittee this year.

As a matter of fact, we have the staff working on plans for hearings in this field. We hope to get to it sometime in May.

I am wondering whether that would be a suitable date when you might, through your organization, be ready to present findings which are resulting from the look that your group has been giving to this matter over the past several years.

I know that because of your close contact with the workers themselves who are subjected to these hazards that there is probably no other group in the country better able to testify on the need for more adequate protection in our compensation legislation for workers.

I know of the great interest of your organization in this matter. I know of some of the preliminary studies that you have already made. I know they will be of great value to the committee.

I hope then that when you stated that later in this session you hope to have an opportunity to explain this need fully, that you might have your presentation ready by early May so that we can get into it sometime early enough to permit us to take any action that might be deemed necessary before the adjournment of Congress.

Mr. BIEMILLER. Mr. Congressman, we appreciate very much the fact that you do plan to hold these hearings.

As you know, we feel they are badly needed. We, ourselves, ran a conference about a year ago on radiation hazards for workers and we produced some data there and since that time we have been continuing our studies.

Many of our international unions now have staff assigned full time to atomic problems, doing nothing else. The most recent of the unions to take that step, for example, is International Brotherhood of Electrical Workers, who brought in a man who had been working in the Hanford operation, to work full time on these problems.

We do have coming up a couple of other conferences that are going to occupy some of our time during early March. The building trades workers will be in this coming week and the following week

we have a conference on the grave unemployment crisis that confronts America, but as soon as those two conferences are out of the way, I intend to call a meeting of the AFL–CIO staff committee on atomic energy which will bring in the people from the different international unions in this field for us to prepare for an early appearance at those hearings.

I assure you we will give you the best of our thinking at that time.

Representative PRICE. I am aware of the work and the amount of research that your group has put in this problem. I know that you will have something valuable to present to this committee.

The General Assembly of the State of Illinois took initial steps toward improving their compensation laws, having in mind radiation hazards to workers, when they increased the statute of limitations provision in their law on matters pertaining to radiation from 1 to 3 years.

Could you give us any idea of the amount of legislative attention to these problems in the various States in the last general assemblies.

Mr. BIEMILLER. Regrettably, slight attention. I was at the meeting of the International Association of Industrial Accident Boards and Commissioners last fall. I had spoken there a year earlier on some of these problems.

The consensus of opinion was that there had been not nearly enough attention paid to this problem. This is another study we have underway at the moment.

We had a comprehensive paper on workmen's compensation presented at our own conference a year ago. We will be bringing that paper up to date.

The AFL–CIO is sponsoring still another conference that I did not mention earlier, on the 15th of April, on the 50th anniversary of workman's compensation.

One of the sessions of that overall conference on workman's compensation will be devoted to bringing up to date our knowledge on just the point you are making.

I regret to tell you that our preliminary observations show not nearly enough attention to this problem. The last time I checked it thoroughly, and this does not take into account all of the sessions, because I have not had a chance to look at all of them, there were only two States which in our opinion were realistically and fully getting at this problem. Those were in New York and California, both of which appeared to be doing a pretty good job in our opinion, both on the question of radiation hazards and getting their workman's compensation laws up to date.

I regretted, for example, that at that time my own State of Wisconsin seemed to be woefully lacking. I understand that some things are happening out there now, because I have been in touch with the industrial commissioners, but we will have that data available for the May conference.

Chairman DURHAM. Mr. Holifield?

Representative HOLIFIELD. The reference that you made, Mr. Biemiller to the State laws, and, of course, that is not only on workman's compensation, but on public safety, I think is very important. I know that the Federal legislation puts the primary responsibility in the Federal Government and I certainly agree with what you have

said about the Federal Government not relinquishing their responsibility to the States unless the States are equipped both legally and personnelwise to handle this problem.

I have been seriously thinking about how to get this done in view of the fact that the States are lagging in passing model legislation.

I am not so sure but what it is not the duty of the Congress to promulgate legislation in the public interest which would prohibit the use of radioactive isotopes in quantities that would be harmful to the public interest if misused and to prohibit the shipping of these federally owned materials into the States that have not discharged their responsibility to the general public.

A few more incidents like we had at Houston and one possible large-scale incident like the Windscale incident in England, I think would set back the progress of atomic energy 25 or 50 years in the United States.

I would like to ask you if your organization in the labor movement would be in favor of legislation that would require States to pass complementary public safety and worker's compensation laws to protect the workers and the public before allowing this Federal material to go into the States.

Mr. BIEMILLER. We would certainly favor, A, maintaining the strictest kind of Federal standards, and, B, exerting Federal authority to make States live up to those standards.

I presume it is that kind of legislation you are talking about here. Most certainly we would support that type of legislation. As we have said here, and we will later—at the hearings that Mr. Price was commenting on—develop in more detail our very grave fears along just the line you have indicated, Mr. Holifield, that just a few more examples like this and the public is going to be scared.

Our unions report, as I think I have told this committee before, that one problem we have in atomic energy installations is that there is a fear that exists of the unknown and that as a result we know that we have run into some psychosomatic manifestations of what people thought were radiation diseases.

It is this kind of problem that we recognize and we are going to have to tackle thoroughly.

Representative PRICE. In the case of the Houston incident, it was pretty well established that the neighbors thought that a person who was radiated could transfer that radiation to other people somewhat in the nature of a contagious disease. There was great alarm there, the neighbors refused to associate with these unfortunate people that were radiated.

Their children were persecuted in the schools. They were asked not to enter certain tradesmen's stores. This sort of thing spread and most of it was founded on ignorance and superstition, but mostly on ignorance of what the true properties were in the radiation field.

I think a big job of education has to be done by the Federal Government and the people that use these isotopes.

In another part of your speech you speak of the patent situation in the legislation and call attention to the fact that in September 1959 the present patent provision will expire.

Now, during recent public hearings the Commission was asked if they had declared, as a matter of public interest, any development

in the past 4 years in the atomic energy field and the answer was that they had not found anything worthy of declaring to the public interest involved.

Notwithstanding that fact that we have had glowing reports year after year on the great technical progress advanced in the field, the Commission has not, under the authority given it under the law to protect the taxpayers of the United States, declared any development accomplished by the few people who have had access to the techniques and contracts on building reactors and other atomic energy projects.

So the present language in the bill apparently is not effecting any protection for the Government and I am wondering if its extension is going to be worthwhile, or whether an entire new look at the patent situation is not involved?

Mr. BIEMILLER. Certainly we would have no objection to taking a completely new look at the patent problem.

You will recall that when the proposal for opening up the patent field developed during the 1954 legislation we had violent objection. We do not believe it ever should have been opened up. We think it should again come back to the original status that patent remain in the public domain.

We would be very happy indeed if this whole issue could be reopened.

We do, as we indicate here, have suspicions. I am willing to admit this would be a very difficult thing to prove, but we believe that some of the progress is being held back as far as any filing is concerned until the present provision does expire.

If I recall the history of the 1954 legislation it was only after considerable fighting on the part of yourself and certain other members of the Joint Committee you were able to get even this provision out of the conference.

I recall that fight very well. We were at least pleased this provision was there. And any way that can be found to strengthen the patent provision we will heartily endorse.

Representative PRICE. We keep hearing rumors of trade secrets that are being withheld and even important developments in certain hardware which is being enclosed in these reactors which then become radioactive and naturally no one is going to know what is inside of them except the engineers and the people who build them.

It is entirely possible that there is an area of technology which is subject to patenting and which is being withheld until after the expiration of this date of September 1959. Because there is a cloud on their equities, until that time, at least, there is a cloud, they may not be sure that the cloud is real, but I am sure in my own mind that there have been a great many things withheld that should be known in the public domain.

The British people take all patents and then they charge a royalty back to the manufacturers. That helps to defray the expenses of the Atomic Energy Commission over there.

In our country we have always taken the other position, that the general welfare of the people is involved to the extent that all patents obtained by the Government should be made available to everyone.

I personally think that the better way to actually advance the technology where Government money is spent and where the patents are

obtained, is that those patents should be made available to all business. And this is the intent of the law as it was passed in 1954, but I don't think it is being carried out by the Commission as carefully as it should be.

Mr. BIEMILLER. Unfortunately there seems to be a number of areas in which the Commission may not be functioning as efficiently and as thoroughly as we think it might have.

Chairman DURHAM. Are there any further questions?

Representative HOSMER. Mr. Biemiller, there is one thing. You mentioned that your staff is making a study on this workman's compensation question. I just want to recall one personal experience that I had in Los Alamos, N. Mex., that it might be well for them to take into consideration.

Ten years ago, my recollection may be a little hazy, but at that time the University of California was operating a lab in Los Alamos which was the largest employer in the State of New Mexico.

Several years before that they had come in and they came under the workman's compensation statutes and due to the nature of the work or due to the secrecy surrounding the work the university was paying the very topmost workman's compensation insurance rate.

That seemed to have gone along for a number of years. We came across these contracts, related them back to the accident rate, and found out they should have actually been paying the very lowest compensation insurance rates because the work was about the safest type of work anybody could get into.

I do not recall the full details of that, but I think it would be a factor to consider in coming up with a well-rounded presentation of the problem.

Mr. BIEMILLER. We will be glad to look at that. My offhand recollection is that the New Mexico law is one of the poorer laws in our estimation. There was a time, I think it was only 4 years ago, that New Mexico finally included radiation diseases as compensable diseases under workman's compensation in spite of the tremendous amount of work that hase been going on in that State.

That is just typical of the kind of problem we have. Idaho, for example, still does not recognize radiation diseases as a compensable disease under their workmen's compensation law, with all of the atomic energy work going on in that State.

Chairman DURHAM. Are there any further questions?

Thank you very much, Mr. Biemiller.

Mr. BIEMILLER. Thank you, Mr. Chairman.

Chairman DURHAM. The next witness is Mr. Clyde Ellis.

We are glad to have you with us this morning.

STATEMENT OF CLYDE ELLIS, EXECUTIVE MANAGER, NATIONAL RURAL ELECTRIC COOPERATIVE ASSOCIATION

Mr. ELLIS. Thank you, Mr. Chairman.

Chairman DURHAM. You may proceed with your statement.

Mr. ELLIS. Mr. Chairman and gentlemen, in summary of our complete statement, I would like to make the following observations. The National Rural Electric Cooperative Association has long manifested a vital interest in the development of economic atomic power reactors. Over the past several years, three rural electric coopera-

tives have participated in the AEC's power reactor demonstration program. Two rural electric cooperatives are still engaged in negotiating contracts under the program.

Second, the rural electric cooperatives, in a much larger sense, also have a vital interest in bringing about full and economic utilization of our atomic energy program, for it is axiomatic that higher per capita output and income are associated with higher per capita consumption of electric energy.

The use of electrical energy continues to double in the United States at the rate of about once every 7½ to 10 years.

This has been going on for four decades, peace or war.

In the rural electric system areas it is doubling about every 5 years.

I might say here that the rural electric systems are paying nearly half a million dollars a day now at that rate for wholesale power and are having great trouble finding enough in many areas.

Providing a continuing and expanding source of low-cost electric energy is basic to any endeavors to increase the standard of living not only of this Nation, but of the rest of the world.

Third, in waging an economic war, against the Communist nations of the world, we must keep these three thoughts in mind:

1. We must be willing and able to supply aid to our allies and prospective allies where and when needed in the form of finished goods and services;

2. We must be in a position to supply these nations with technical information and equipment for they, too, wish to build their own industrial base in order to provide the means to increase their own living standards; and

3. We must also maintain our own technical superiority and increase our own standard of living so that we can continue to serve as a symbol of democratic free enterprise to these nations, including the underdeveloped growth areas of the world.

ATOMIC ENERGY PROGRAM TO DATE

Fourth, it is obvious and readily apparent, from even a cursory review of the record, that the atomic energy program in this country to date has been financed almost totally by the Federal Government. Atomic energy technology in this Nation is a publicly created technology.

Fifth, but yet we find private commercial power companies continuing to engage in false propaganda implying and stating that the atomic energy program in this country has been fostered and developed exclusively or almost exclusively by so-called private enterprise.

Incidentally, they are not part of the private enterprise systems themselves, according to the Congress of the United States, State legislatures, and the courts.

This is all part of the attempt of the profit power companies to discredit the role, function, and achievements of the Federal Government, and to destroy the cooperatively and publicly owned power systems and establish a total monopoly over the Nation's power supply.

6. It cannot be argued, that measured against past domestic achievements, the United States has not progressed in the development of atomic-energy technology in the last year. But the facts remain, contrary to implications of the Chairman of the Atomic Energy Com-

mission, Admiral Strauss, that these achievements have come about almost exclusively as a result of the impetus, research, and economic aid given by the Federal Government, and they have been much too slow coming.

7. Admiral Strauss, the mathematical gymnast, continues to engage in his "numbers game"; he still continues to talk about all the reactors we have, that is, private enterprise by implication, have built, are building, have under construction, or are in the planning stage. And when close analysis of such statements is made, one finds that of the reactors actually built, they almost invariably have been built by the Federal Government.

8. But in order to get a well-rounded picture of our success and achievements in the development of atomic energy for peaceful purposes, we cannot be content with measuring our success only against our own previous accomplishments. We must compare our progress against that of other nations.

OUR RELATIVE PROGRESS

9. In making such a comparison, it is my belief, as one writer and close follower of this program has stated, that:

> * * * We have disappointed the world and our own hopes. Either the job we took on was too tough and we promised too much, or we have not done as well as we should.

In terms of actual construction of full-scale operating nuclear reactors, it seems apparent that the British are well ahead of us, and that the Soviets are rapidly catching up with us, if they have not already done so. It may be true that the United States still leads the world in atomic energy know-how, but how long can this last under the current methods of operation or lack of operation?

CONCLUSIONS AND RECOMMENDATIONS

10. Based on an analysis of the results of our atomic-energy program, and after a careful reading of the opinions and thoughts of the reactor experts, I believe the following conclusions and recommendations are in order:

AGGRESSIVE STEPS AND POSITIVE LEADERSHIP NEEDED

(*a*) The Atomic Energy Commission should be directed—ordered, if you please—to take aggressive steps to provide the needed positive leadership and corresponding responsibility for rapid development of the full potentialities of atomic-energy technology.

This would entail taking the responsibility for Federal development of the necessary types, sizes (both large and small scale), and needed successive generations of types and sizes of nuclear reactors so that we can produce in the immediate future economically competitive reactors for use both here and abroad.

ENDORSEMENT OF GORE-MONRONEY-HOLIFIELD BILL

(*b*) We recommend, and strongly endorse passage of the recently introduced Gore-Monroney bill (S. 3000) and similar legislation introduced by Congressman Holifield (H. R. 2154). We support this

legislation because it would provide the necessary impetus needed by this country to recapture its leadership in the development and successful operation of nuclear energy technology.

We do not support this legislation because, as some people argue, the NRECA supports all public power legislation. We do not think this legislation is public power legislation. This legislation simply provides the wherewithal to successfully arrive at the construction and completion of some full-scale atomic reactors.

This legislation would, in its domestic nuclear power aspects, authorize and direct the Atomic Energy Commission to accelerate the United States atomic energy program through the construction of—

large-scale prototype power reactor demonstration facilities—

constructed at sites of Atomic Energy Commission facilities and with power output to be used by the Atomic Energy Commission itself.

In addition this legislation directs the Atomic Energy Commission—

To pursue with all practical speed the perfecting of laboratory processes for the production of usable energy for controlled thermonuclear reaction.

As I say, we wholeheartedly endorse such legislation, but I would like to take the privilege of suggesting one amendment. I believe these bills should be amended to authorize and direct the Atomic Energy Commission to develop the technology and construct economically feasible full-scale atomic reactors in the 10,000-kilowatt to 40,000-kilowatt size range.

I suggest this not only because so many of the underdeveloped countries are in dire need of such sized reactors, but also because of the fact that if the rural electric cooperatives, the public utility districts and the municipal utilities are to survive they must have access to small sized nuclear reactors.

The yardstick: Providing such smaller scale reactors is of tantamount importance in assuring the continued effective functioning of the competitive yardstick. With a few full-federally operated nuclear reactors, as envisioned in these bills, and a compliment of publicly and cooperatively operated atomic reactors, the American people will continue to have the necessary data on hand to accurately measure the adequacy and true cost of atomic power production—something that would be impossible to determine by private power company operations alone.

Recapturing world leadership: It is our firm belief that if the Gore-Monroney-Holifield bill is passed, if now and in the future ample funds are provided for our atomic energy program, and as the bill directs, if the objectives and goals of our atomic energy program are clearly outlined and defined; if responsibility is fixed and authority given—and, if it will only be recognized that the Federal Government is the only one in a position to provide the necessary funds, and is the only one that has the necessary facilities and personnel to provide the needed stimulas and direction—if all these conditions are met, then I think we will be in a position to recapture and maintain our world leadership in this most vital of all technological discoveries.

Chairman DURHAM. Thank you very much, Mr. Ellis.

Do you desire your complete statement placed in the record?

Mr. ELLIS. The full statement, if I may.

Chairman DURHAM. Without objection, that may be done.

(The statement referred to follows:)

STATEMENT OF CLYDE T. ELLIS, GENERAL MANAGER, NATIONAL RURAL ELECTRIC COOPERATIVE ASSOCIATION, ON SECTION 202, STATUTORY HEARINGS, BEFORE THE JOINT COMMITTEE ON ATOMIC ENERGY, FEBRUARY 28, 1958

Mr. Chairman and gentlemen of the committee, my name is Clyde T. Ellis. I am general manager of the National Rural Electric Cooperative Association. NRECA is the national service organization of the rural electric systems representing approximately 92 percent of them. These systems serve some 3.9 million consumer connections in the farm and rural areas of 44 States and Alaska.

RURAL ELECTRIC COOPERATIVE INTEREST IN THE ATOMIC ENERGY PROGRAM

As this committee knows, NRECA has long manifested a vital interest in the development of economic and efficient atomic reactors. Three member systems of NRECA have attempted to participate in the power reactor demonstration program of the Atomic Energy Commission. One of these participants, the Wolverine Electric Cooperative in Michigan, I believe, has since been forced to withdraw, not due to any hesitation or inadequacies on its part, but due to the fact that the industrial firm which had negotiated for construction of the reactor plant had raised its price beyond all reason. The second rural electric cooperative, Chugach Electric Association, at Anchorage, Alaska, is still in the preliminary planning stage of its proposal; in phase one of a three-phase program, and not until sometime in the future will feasibility of this project be determined. The third rural electric cooperative, Rural Co-op Power Association at Elk River, Minn., after a serious setback caused by the original reactor contractor backing out, as in the Wolverine case, seems to be back in the picture now, the AEC having recently accepted a bid from another contractor.

As you know, the electric utility industry is perhaps the fastest growing major industry in the United States—doubling its sales about every 7½ to 10 years. And the rural segment of the industry is doubling even faster—about every 5 years. Where the capacity and energy are to come from, to double again in the near future, is uncertain. The very thought staggers the imagination. For this specific reason we are vitally interested in exploring all of the possible new sources of energy.

During the fiscal year 1956, the last year for which complete and detailed data are available, REA borrowers paid $132.4 million for their wholesale power. They paid the largest amount of this, $64.3 million, to the private power companies. The REA borrowers generate only about 15 percent of their energy input. However, this 15 percent is very important. It is important to have an alternative source of power; it is important as a yardstick; it is important to areas that have no other source of power.

It is natural also, for the rural electric cooperatives to look toward the generation of low-cost atomic energy—atomic reactors so located in rural areas that they may be able to avoid much of the very expensive cost of installing transmission lines over long distances. It is natural, too, for the rural electric cooperatives to look for the generation of economic atomic energy because they are right now, in many areas, having a hard time in finding a source of wholesale power to meet their immediate requirements. This is due to a number of factors, including the attitude taken by many of the private suppliers of the rural electric cooperatives, and the attitude taken and policies instigated by the administration concerning the full development of our water resources, and the way in which costs on those projects already developed are being reallocated.

ABUNDANT ELECTRICITY—A NECESSITY FOR HIGH LIVING STANDARDS

In a much larger sense, however, the rural electric cooperatives are further interested in maintaining and providing the means for increasing living standards not only of this Nation but of the rest of the world.

It is axiomatic that higher per capita output or income are associated with higher per capita consumption of energy. As has been pointed out in a recent National Planning Association pamphlet, Productive Uses of Nuclear Energy, "* * * Despite substantial deficiencies in the data concerning both national income and energy consumption, there is ample evidence of a rough but unmistakable positive correlation between per capita incomes and per capita energy

consumption. Large differences in income are associated with large differences in energy intake, and we may take it for granted that no country at this age of history can enjoy a high per capita income without becoming an extensive consumer of energy."

We owe it not only to ourselves and to this Nation, but to the nations and peoples of the world, to do everything in our power to provide the necessary technological base to assure continuing and expanding sources of electric energy.

In waging an economic war against the Communist nations of the world, we must keep in mind (1) that we must not only supply aid to our allies and prospective friends where needed in the form of finished goods and services, but (2) we must be in a position to supply these nations with technical information and equipment, for they, too, wish to build their own industrial base for a prosperous society, and (3) we must also maintain our own technical superiority and increase our own standard of living so that we can continue to serve as a symbol of democratic free enterprise to these underdeveloped growth areas. And, I repeat, basic to the industrialization of any society or nation is an abundant source and widespread use of low-cost electric energy.

Phrased somewhat differently, and perhaps most apropos, is the recent statement made in a speech given by Senator Albert Gore, before the National Western Mining Conference in Denver, Colo. Senator Gore said: "We must be prepared to compete with the Soviets," because atomic-energy technology and all its promises, "* * * has caught the imagination of the peoples of the world, and the United States cannot afford to come in second or third best."

It serves this country in good stead for this committee to hold these statutory 202 hearings each year. These hearings give us a chance to reflect on what has happened or has not happened to such an atomic-energy program as we have over the past year—our successes, if any, our failures—and it also gives us an opportunity to present and discuss new ideas for the consideration of this committee and the Congress. With this purpose in mind I would like to (1) review briefly our meager progress in the atomic energy program over the last year, and (2) to suggest and/or support ideas for development and acceleration of the peaceful uses of atomic energy.

A BASIC CONFLICT

Before I begin let me state a few facts which in my opinion point out a basic conflict. It is a well-established fact that the privately owned public service electric power companies in the United States have long engaged in concerted efforts to destroy the cooperatively and publicly owned power systems and establish a total monopoly over the Nation's power supply. These so-called private power companies have always opposed any effective Federal program to provide the people with low-cost energy in any way, shape, or form. In keeping with this tradition these profit power companies now are in the process of attempting to assure their control over the development of what potentially at least could constitute our largest power resource—the resource of atomic energy.

The gall of these privately owned electric utility companies who argue that the Government has no business in this atomic energy field seems fantastic and incredible to me. This fact remains undisputed: Atomic energy technology is a publicly created technology. The source of virtually all of our reactor technology has been the AEC reactor laboratories, built and operated with public funds.

The Federal Government has invested over $15 billion in the atomic-energy program to date. In addition to billions and billions of dollars spent in developing the original technology for the destructive uses of atomic energy—much of this technology being easily converted into peaceful uses of atomic energy—the cost of duplicating the AEC reactor laboratories today would probably approach three-quarters of a billion dollars. Also, an estimated additional $450 million in public funds has been spent to date on the civilian power reactor development in construction programs, and another $900 million on military reactor development which has also benefited the civilian-reactor program. In addition, public expenditures for civilian-power reactor development are expanding, not contracting, as indicated by the fact that in the next fiscal year civilian power reactor development is estimated to cost some $124 million, compared with about $77 million in 1956–57 and $118 million in this fiscal year, exclusive of construction costs. These facts belie the contention made by many of the profit-type electric utilities that much, if not all, of the investment and technological advances made in the field of atomic energy have come about through or from private sources.

ACHIEVEMENTS IN THE UNITED STATES ATOMIC ENERGY PROGRAM IN THE LAST YEAR

Measured against previous technological advances in the science of atomic energy in this country, the achievements over the past year, any critic would have to admit, have been impressive, even if far short of what many of us believe must be done.

Excluding full-scale plants, I think we would all agree that our atomic energy research and development program is very extensive. A substantial number of pilot model power reactors have been completed, each producing small quantities of power. And, in December 1957, the United States placed on the line and in operation the 60,000-kilowatt pressurized water reactor at Shippingport, Pa. (Note I said the United States and not the Duquesne Power & Light Co. placed it on the line.) Also, the United States heralded the startup of the privately constructed—largely with technical knowledge gained from Government expenditures, of course—5,000-kilowatt plant built by General Electric Co. in California.

The "old numbers game" again

We have the word of Chairman Strauss that the United States made, or as he implies, private enterprise made, great progress in atomic energy technology in the last year. In a most complimentary, self-praising report, Admiral Strauss stated that 5 small experimental reactors and 1 large nuclear powerplant went into operation in the last year.

Continuing, the admiral pointed out that "thanks to the relaxation of the Government's monopoly," atomic power, now unfettered, has expanded to the point whereby private industry (as the admiral implied) has "built or had under construction in 1957 a total of 75 reactors of which 42 are for civilian or military power."

I feel called upon to point out, lest anyone swallow this statement without the proverbial grain of salt, that Chairman Strauss is again engaging in his old "numbers game." In this prepared report, which verges on the deceptive, the admiral strongly implies that progress made to date in this program has been due almost exclusively to the administration's "partnership program" and to the "ingenuity, initiative, managerial capacity and capital investment of our free enterprise system," when, as a matter of fact, the accomplishments made in 1957 were due almost solely to the federally financed and administered reactor development program.

The admiral should have pointed out that of the 5 small experimental reactors and the 1 large nuclear power reactor which went on the line in 1957, only 1, the General Electric, California, project, could be said to be of private enterprise—and that is stretching a point, for even its success rested heavily upon previous research and development by an AEC reactor development laboratory. The remaining five projects which the admiral laudatorily credits to private enterprise were achievements of the Government's reactor development laboratories and AEC contractors—at Government expense.

But what about the rest of these 42 civilian or military reactors? Is it true as the mathematical gymnast, Admiral Strauss, implies, that progress on these reactors has only come about due to the "relaxation of the Government monopoly"?

Of these 42 reactors "built or under construction," I am informed that some 20 are Navy reactors entirely financed by the Federal Government, and that another 13 are Federal reactor projects involving slight private financing in only a few cases.

Certainly there is a wisp of accuracy in the admiral's statistical distortions, for it is true that in addition to the so-called private-enterprise 5,000-kilowatt GE reactor there is also under construction the so-called privately financed reactors of the Power Reactor Development Co., Consolidated Edison, and Commonwealth Edison.

But the fact still remains, that taken in its totality, research and development funds, plutonium credits, etc., included, the atomic energy program in this country has not been stimulated, fostered, and nurtured due to a cessation of Government intervention or activities, but rather as a result of Federal Government intervention, finance, and activities.

In order to get a well-rounded picture of our success and achievements in the development of atomic energy for peaceful purposes, we cannot be content with measuring our success only against our own previous accomplishments. We must compare our progress against that of other nations.

As stated in the preamble of the final report of the 12th American Assembly on Atoms for Power: United States Policy in Atomic Energy Development, dated October 20, 1957:

"The United States has attained a worldwide reputation for preeminence in science and technology. Whether we like it or not, the maintenance of the United States position in the image already fashioned is a factor in the present world struggle. In such a situation the position of the United States is inescapably competitive.

"The United States policy in atomic power development must, for this and other reasons, be appraised not only in domestic but also in international terms. Conclusions reached by weighing our existing national fuel resources and needs and present costs of power produced by nuclear reactors may need to be modified by the foreign policy considerations."

And just how well have we done in a relative sense, compared to the progress made by other countries in developing the means and technology to utilize atomic power for the generation of electricity?

One expert, the Honorable Eugene M. Zuckert, former member of the Atomic Energy Commission, contends that:

"* * * We have disappointed the world and our own hopes. Either the job we took on was too tough and we promised too much, or we have not done as well as we should."

And how does Mr. Zuckert arrive at this conclusion?

BRITISH PROGRESS

Perhaps because the British, with less money, fewer scientists and fewer laboratories, are significantly ahead of us in the design and construction of large commercial plants. Perhaps because the British already, for about a year now as I recall, have the Calder Hall plants already in operation serving a large number of residents and commercial loads. Perhaps because the British already have 4 large atomic power stations of 2 reactors each under construction, with a rated generating capacity ranging between 275,000 kilowatts to 500,000 kilowatts scheduled for completion in 1960–61. Perhaps, because the British, as reported plan in the immediate future to sign another contract for a station of 800,000 kilowatts. Perhaps, because the British plan by 1966 to have some 5 to 6 million kilowatts of installed nuclear capacity. And perhaps because the British are already in the process of selling a large power reactor abroad to Italy.

RUSSIAN PROGRESS

Now what about the Russians?

I am informed that the Russians already had a small power reactor in operation—a long time before ours—and that they plan to have a 420,000 kilowatt reactor station (with two reactors) in operation by 1960. Also, it has been reported that the Soviets plan an additional 400,000 kilowatts reactor station, again with two reactors, which they plan to complete by 1960 or 1961.

Furthermore, it has been reported that the Russians have agreements with some of their allies to supply them with power reactors in the near future, and perhaps as an indication of the validity of this statement, we know that there is now being constructed in Russian-controlled Czechoslovakia a 150,000 kilowatt power reactor which is scheduled to be completed by 1960.

On the basis of this relative comparison between the United States, Great Britain and the Soviet Union, one might well be in a position to argue that the United States in terms of its accomplishments in the research, development and construction of atomic reactors is running a poor third.

It is possible, I concede, that, as Mr. Zuckert says:

"It may well be that the United States still holds its lead in atomic energy know-how. It is quite evident, however, that we are not ahead in any race to get atomic energy powerplants into being."

WHY ARE WE BEHIND?

How does one account for the fact that as regards the actual construction of operating atomic reactors we appear to be so far behind other nations? I would explain our position this way. First, our policy seems to be that since we cannot justify the construction of atomic reactors in this country because at present they cannot economically compete with conventional plants there is no need at the current time to employ men and materials for such construction. And,

secondly, in its zealous desire to turn the entire atomic energy program over to private enterprise—so called—the administration has not provided the necessary positive leadership and direction needed to develop this new and impressive technology.

In my opinion, the first of these arguments contains faulty reasoning because it has long been known, as W. Kenneth Davis of the Atomic Energy Commission and many others have pointed out, that we must build and operate at a loss a whole succession of various types of full-scale plants before any one type or types of reactors can be developed which will compete economically with conventional units. We cannot wait until we deplete our conventional sources of fuel. The whole history of development of successful technology can be written in terms of trial and success. One does not create in a vacuum, without previous experimentation and research, the "most efficient" or "best" technology of any kind.

In the words of Senator Gore:

"Our supplies of conventional fuels, though comparatively abundant, are not inexhaustible, and known reserves are far from sufficient to meet prospective energy requirements. The world looks to uranium to fill the need."

And this need cannot be filled unless we begin now in a sincere and determined effort to develop nuclear energy technology.

And to the second argument, I am somewhat at a loss for words. Apparently the administrative powers that we have placed the welfare of a minute segment of the business population over the welfare of the American people and the rest of the world's population.

I cannot comprehend the alleged apprehension of the administration. In other areas; namely, foreign aid, the President has virtually begged the Congress to provide ample funds so that our foreign alliances can be maintained. But why not ample funds, positive leadership and positive action for our atomic-energy program?

Does the President believe the periodic platitudes voiced by Admiral Strauss that private enterprise is doing and will continue to do the needed research and development in this field? Surely not, for even the privately owned electric utility industry by its own admission and action has proved that it does have the necessary funds, personnel or adequate economic incentive to undertake the costly desearch and experimentation needed to develop an adequate, competent, and competitive atomic-energy program.

If the administration has not been convinced up until this time that we do not have much of an atomic-energy program, perhaps the results of two recently conducted surveys will move it to this conclusion. One survey made by Nucleonics, the technical magazine of the atomic-energy industry, concluded that practically all of the nuclear-equipment industry feels that our nuclear-power program must be speeded up, and that this will require Government financing—subsidies to use a dirty word.

Another survey, this one made by the Atomic Industrial Forum, concluded that almost 70 percent of its members, comprising operating and manufacturing companies and other institutions, believed that Government activity in this field should be stepped up, and further a total of 62 percent of those replying to the survey concluded that any "expansion activity—Government or private—should be part of a new national atomic-power program built around Government-sponsored research and development activities in non-Government facilities, modification of Government procurement policies to increase economic incentives and Government-sponsored research and development in the national laboratories"—in other words, again, more bigger and better subsidies to private enterprise.

WHERE DO WE GO FROM HERE?

It just happens that perhaps the best indication of what our program needs and where we should go from here can be gleaned from the conclusions reached by some of our most qualified reactor experts. We have had the benefit of the thinking of some of these experts through release of a summary material of a seminar held between them and the Joint Committee on Atomic Energy on November 21, 1957, and by the considered opinion of such men as W. Kenneth Davis of AEC.

On the basis of this seminar the conclusions reached were as follows:

"1. There is today no clear-cut Government program with regard to atomic-power development. We need clear-cut national objectives, both with respect to domestic and international development.

"2. The AEC power demonstration program, as it now exists, is not by itself proving adequate for the work that has to be done. Additional funds and efforts will be required if we are to develop nuclear power technology at a rate sufficient to meet the needs of national and international policies.

"3. Private industry alone cannot carry the full load in developing and constructing reactors. More Government support and money is necessary.

"4. Availability of technical manpower is not today a limiting factor in developing reactor technology. There are, however, some instances where temporary shortages of highly skilled people occur but these deficiencies are in cases where the skills can only be acquired through work and experience in the field.

"5. The Government should determine and firm up how much money it is willing and plans to spend within the next several years in the civilian power program. (This could be a 5-year or a 10-year plan or comparable.) Once having made that determination and it is know how much money will definitely be allocated to the program over a given period of time, details can then be worked out as to how the money will be spent to cover the various elements of the program.

"6. In developing reactor technology it is necessary to build reactors large enough to develop the necessary technical information and there must be several succeeding generations of a given type if we are to prove out that type. In building full-scale reactors it is usually necessary to go through the following steps:

"(*a*) Small experimental model,

"(*b*) Intermediate size,

"(*c*) Full scale project.

"It will be only after several succeeding generations of full scale reactors of a given type before we will succeed in reaching or approaching the stage where the economic value of a reactor concept can be determined.

"7. We should continue to give strong support to advanced reactor concepts and the necessary research and development work involved in these advanced concepts. We must not drop them or cut back on them to specialize only on the water types.

"8. Additional reasearch and testing reactors (similar to MTR and ETR) need be built by the Government. We cannot depend entirely upon private industry to build and support research and test facilities. This includes hot cells and supporting equipment. Industry often has excess capacity in its own facilities but competitive considerations have a tendency in some instances to discourage the use of one firm's facilities by another.

"9. The Government must support wide engineering research of a type that cuts across the entire field and is not limited to one of several particular reactor concepts. Such research is an essential part of our reactor development effort and should be utilized to the maximum to prove out materials and components which would otherwise have to receive their preliminary tests in more costly full-scale reactors.

"10. There are too many small 'subcritical' research and development organizations in the nuclear power field at the present time, which tend to dilute effort and trained manpower. Some suggestions were made as to consolidating efforts through joint enterprises comprised of several organizations."

In addition, AEC Reactor Development Director, W. Kenneth Davis, has the following to say concerning the needs of our atomic energy program, as quoted in the Atomic Industrial Forum's magazine, Forum Memo:

"There is need for a specific and definitive governmental objective and a stable long-term governmental program for achieving this objective in order to facilitate planning by industry, and to stimulate industrial investment in nuclear energy facilities."

Continuing, Mr. Davis points out that:

"Because of the international situation and United States commitments there is need for an accelerated power reactor development program which is not required by domestic economic needs."

And finally, Mr. Davis points out that:

"The attainment of economic nuclear power in the United States with any concept necessitates carrying it through a series of staggered prototype stages, perhaps 3 to 5 in number. * * *"

My interpretation of the above conclusions and statements and other supporting evidence, is: (1) Our current atomic energy program has neither direction, purpose nor positive leadership; (2) private industry is not in a position to develop the technology required for a successful atomic energy program; or phrased somewhat differently, the partnership approach advocated and used by

the AEC has left much to be desired; and, (3) we will not achieve success in this program without greatly increased Federal expenditures and full and accelerated use of such existing Federal facilities as our national laboratories.

As one informed observer of our atomic energy program pointed out in a speech at the 1958 annual meeting of the National Rural Electric Cooperative Association:

"AEC has been using the partnership approach for several years and it has proved unsatisfactory. Its weaknesses cannot be cured by pumping in more public money. The basic flaw in the partnership program is that it has relinquished the initiative and the leadership to the private power corporations. These have neither the proper incentives, the technical competence nor the funds to do the job.

"The people of the United States have highly important international and domestic objectives to attain, and it is unrealistic to assume that private corporations can or should accept the principal risks and carry out the primary burdens associated with meeting these objectives. Yet this is what the AEC partnership policy assumes. * * *"

RECOMMENDATIONS

Speaking for the National Rural Electric Cooperative Association, I think what I have outlined here today logically leads to the following recommendations:

(1) The Atomic Energy Commission should be directed to take aggressive steps to provide the needed positive leadership and corresponding responsibility for rapid development of the full potentialities of atomic energy technology. This would entail taking the responsibility for Federal development of the necessary types, sizes (both large and small scale), and needed successive generations of types and sizes of nuclear reactors so that we can produce in the immediate future economically competitive reactors for use both here and abroad.

(2) We recommend, and strongly endorse passage of the recently introduced Gore-Monroney bill (S. 3000) and similar legislation introduced by Congressman Holified (H. R. 2154). We support this legislation because it would provide the necessary impetus needed by this country to recapture its leadership in the development and successful operation of nuclear energy technology and would provide the country with a minimum atomic energy program. We do not support this legislation because, as some people argue, the NRECA supports all public power legislation. We do not think this legislation is public power legislation. In regard to this matter above, this legislation simply provides the wherewithal to successfully arrive at the construction and completion of some full scale atomic reactors.

This legislation would, in its domestic nuclear power aspects, authorize and direct the AEC to accelerate the United States atomic energy program through the construction of * * * "large-scale prototype power reactor demonstration facilities * * *" constructed at sites of AEC facilities and with power output to be used by the AEC itself.

In addition, this legislation directs the AEC "To pursue with all practical speed the perfecting of laboratory processes for the production of usable energy from controlled thermonuclear reaction."

As I say, we wholeheartedly endorse such legislation, but I would like to suggest one amendment. I believe these bills should be amended to authorize and direct the Atomic Energy Commission to develop the technology and construct economically feasible full scale atomic reactors also in the small 10,000 kw. to 40,000 kw. size range.

I suggest this not only because so many of the underdeveloped countries are in dire need of such sized reactors, but also because of the fact that if the rural electric cooperatives, the public utility districts, and the municipal utilities are to survive they too must have access to the small sized nuclear reactors.

Providing such a smaller scale reactors is of tantamount importance in assuring the continued effective functioning of the competitive yardstick. With full-federally operated nuclear reactors, as envisioned in these bills, and a compliment of publicly and cooperatively operated atomic reactors the American people will continue to have both an element of competition and the necessary data on hand to accurately measure the adequacy and cost of private power company service.

It is our firm belief that if the Gore-Monroney-Holifield bill is passed, if now and in the future ample funds are provided for our atomic energy program, and as the bill directs, if the objectives and goals of our atomic energy program are

clearly outlined and defined; if responsibility is fixed and authority given—and, if it will only be recognized that the Federal Government alone is in a position to provide the necessary funds, and alone has the necessary facilities and personnel to provide the needed stimulus and direction—if all these conditions are met, then I think we will be in a position to recapture and maintain our world leadership in this most vital of all technological discoveries. But I do not believe this can be done under the leadership of Admiral Strauss.

Chairman DURHAM. Mr. Price.

Representative PRICE. Mr. Ellis, at the top of page 2 you omitted to read something in your prepared statement that the Atomic Energy Commission has recently accepted a bid from another contractor. You are talking there about the Rural Power Co-op Association of Elk River.

Have they agreed to a contract on the Elk River reactor?

Mr. ELLIS. I understand that is in the very latest stages, that there are two bids and that they both look much more hopeful than had been thought possible some months ago.

Neither bid has been accepted.

Representative PRICE. That is still in the state of negotiation on a bid?

Mr. ELLIS. That is correct. I understand that neither bid has been accepted or had not as of 2 or 3 days ago. Action is expected right away, though.

I understand that Mr. Ed Walter, the manager of Rural Power Cooperative at Elk River, will be before your committee on Monday.

Chairman DURHAM. Do you know of any other rural cooperatives that are thinking about any new proposals to submit to the commission?

Mr. ELLIS. Well, there are several, Mr. Chairman, which have been studying the opportunity, some groups, such as the Kansas Statewide have moved in that direction, the Kansas State Association of the Rural Electric Cooperatives, but they are being slowed up and held back by the lack of progress by these three who have been trying so hard to get started with some development.

We have had to take that attitude in discussing the program with them. We can't be too encouraging until we see where we are with these three efforts—until they have progressed much further than they have to date.

Chairman DURHAM. That has been primarily due to financing, has it not, to a large degree?

Mr. ELLIS. You mean the contract submitted? The amounts in the contract submitted I think constituted a great barrier, but we believe that primarily it has been due to the determination made long ago in AEC not to permit the rural electric cooperatives to participate in this program.

Chairman DURHAM. I felt when these three came in that, of course, that was a pretty good indication that there was not anybody prohibiting them from coming in, if they were coming in submitting their proposals and got ther financing, all of them were taken in under the proposal.

Mr. ELLIS. That is true, but we think the proposals and the whole approach has been of such a nature as to make it almost impossible for the rural electrics to participate and evidence of it is that they have not participated, even though they have been trying very hard

from just as far back, if not further back, than the commercial power companies have been trying.

Chairman DURHAM. They have all had the same difficulty. Their situation is no different from anyone else in the financing end of it, the capital costs and the overall costs of the plant.

It has all showed up in both ends.

Mr. ELLIS. Yes, sir; but we think the rural electric cooperatives have not been very welcome around AEC and we think, frankly, the reason for it is the tremendous influence which the commercial power companies have had in AEC and that there has been an attitude toward the rural electric cooperatives of, to say the least, coolness.

Chairman DURHAM. I do not know anything about that, but as far as the Congress is concerned we have provided means and methods whereby they could come in and participate like anybody else.

Mr. ELLIS. We think the Congress virtually directed AEC last year to "get on the ball" and go forward with these three generation and transmission electric cooperatives. These cooperatives have been working long and hard and spent a lot of money to try to participate in the program and we think that AEC has, to a great extent, defied that virtual mandate from the Congress.

Chairman DURHAM. These types were designed to set up a kind of criteria for small co-ops and people like that that wanted to get into this business for that purpose alone.

Mr. ELLIS. Mr. Chairman, I understand, and with me here are our economist, Dr. Paul Nelson, and our electrical engineer, Charles Robinson, who can provide details with which I am not familiar, but I understand that round two is now closed.

Chairman DURHAM. That is right.

Mr. ELLIS. And that the rural electric cooperatives are not eligible to participate in round three.

So that by AEC's own rules we are excluded now from coming in with new proposals.

Representative PRICE. Mr. Chairman, may I ask a question?

Chairman DURHAM. Mr. Price.

Representative PRICE. I just throw this out with an open mind, knowing the financial problems involved in the early stages of the development of this program.

I have never been convinced that it was a very economically sound program for any company to be involved in. What advantage does the REA co-op feel that they would have being in the program at this early stage?

Mr. ELLIS. This, Mr. Price, we feel it is coming. We feel we may even be in better position to take advantage of smaller nuclear reactor generating stations particularly, than the big companies because of our great distances, operating over some million and a half miles of rural lines; because about as expensive a thing as we have to do is build the heavy transmission lines to get our power out to the substations. And, if some day we can have automatic or near automatic reactors out there in the substation areas, it will obviate the building of a lot of heavier transmissions lines and they may, therefore, be feasible at those spots long before they are feasible around Detroit or New York or Chicago.

That is one thing.

Another thing is, we believe that there is plenty of history to support a strong feeling that the commercial power companies would attempt to preempt, in cooperation with industrial companies that do the development work, patents which are vital to us; that they would probably tend to hold back the whole program if they felt that nuclear development might make it possible for those whom they do not like, for what they regard as their competition, that is the municipal, smaller municipals, the power districts, the co-ops, to have some economic advantage by being able to improve their relative economic position in the use of such reactors.

Representative PRICE. Understand, I am not arguing with you. I am just trying to see the justification for the REA co-op being involved in this program.

What you say there throws some light on it.

Let me ask you this question: In the past have not your dealings with the equipment manufacturer been the problem? Is that not your problem, to deal with equipment manufacturers to build your power stations?

Mr. ELLIS. We think we have two problems. One is that we do not know how far the commercial power companies will go to keep us out of the atomic energy program.

Representative PRICE. You do not know whether or not the equipment people who you are dealing with might themselves be shut out of the program if you did not cooperate with them in the building of small reactors?

Mr. ELLIS. Yes, and we do not know to what extent possibly they may be influenced by companies, by commercial power companies, who are buying greater quantities of materials from them in their dealings with us.

Representative PRICE. You see the point I am trying to drive at?

Mr. ELLIS. I do.

Representative PRICE. How would you suffer if the equipment people with whom you have always done your dealings, who have in the past built your power stations and so forth, have not been shut out of the projects?

Would you not then have access to them as you do now—in the atomic age as well as in the conventional age?

Mr. ELLIS. I think one could argue that.

Representative PRICE. I am not arguing that with you; I am just throwing that out.

Mr. ELLIS. I don't think that necessarily follows. You see, we often need different types of equipment than the commercial companies need.

For instance, we pioneered the practice of letting the consumer read his own meter. The cost of traveling a million and a half miles of line a month is a staggering cost. We have eliminated that.

But to do that we had to get a meter the farmer could read and not one of these complicated ones with several wheels running in opposite directions, and we had to get the cost down. To do that took several years because American manufacturers refused to make the meter for us.

We had to go to Canada and make arrangements to have the meters made in Canada before American manufacturers capitulated and agreed to make them in the United States.

We believe that certain technology might be withheld from us. We believe that there ought to be continuing exploration and we are asking an amendment here to the bill to require the AEC to put in some of these small and intermediate size reactors, as well as the big ones, if the bill is passed.

Representative PRICE. I think it is important to have these questions answered and answered in the record, as we have them today, because it has been suggested that it might be the better part of wisdom for REA co-ops to sit back and await the development of this new art because they would have access to it through their normal equipment sources anyway.

Mr. ELLIS. There is another reason, and a big one. That is the yardstick reason.

We do not believe we know now the cost of the Shippingport plant. We do not believe we have any way of knowing and we doubt that any agency of the Federal or State Government will ever know.

Chairman DURHAM. It has cost $64 million. That gives you a pretty good indication of what it costs.

Mr. ELLIS. Yes, but we don't know how much of that, Mr. Chairman, is a cost that we might have been able to avoid somewhere.

That is what I am trying to say. The value of having our own experience and know-how is something that might help us to give this committee some information.

Chairman DURHAM. That is why we made it so that the rural co-ops could come into this picture and help us in building these reactors and gain more knowledge and more technical know-how. That is why we did it.

Representative PRICE. I think it is important to have those questions answered. I am glad to afford you the opportunity to put them in the record.

Mr. ELLIS. Thank you, sir.

Chairman DURHAM. Are there any further questions?

Thank you very much, Mr. Ellis, for your statement.

The committee is adjourned until 2 o'clock this afternoon here in this room.

(Thereupon, at 12:25 p. m., the committee was recessed, to reconvene at 2 p. m., same day.)

AFTERNOON SESSION

The committee reconvened at 2 p. m., upon the expiration of the recess.

Chairman DURHAM. The committee will be in order.

This is a continuation of the hearings of the Joint Committee on section 202 under the act of 1954.

I believe our first witness this afternoon is Mr. Hibbert Hill, of the Northern States Power Co.

I understand you are taking the place of Mr. King.

Mr. HILL. Yes, sir.

I have a short statement, Mr. Durham, if I may.

Chairman DURHAM. All right. You may proceed.

STATEMENT OF HIBBERT HILL, CHIEF ENGINEER, NORTHERN STATES POWER CO., MINNEAPOLIS, MINN.

Mr. HILL. This statement is on behalf of what we call the CRBR project, which is the joint project of the Northern States Power Co. and the Central Utility Atomic Power Association.

Mr. HILL. My name is Hibbert Hill. I am chief engineer of the Northern States Power Co., 15 South Fifth Street, Minneapolis, Minn.

Northern States Power Co., with the assistance of 10 neighboring utilities, has undertaken the construction of an advanced type of boiling water reactor powerplant under the third round power reactor demonstration program.

A contract with AEC, effective November 22, 1957, provides for assistance as follows:

1. Preconstruction R. and D.	$5,000,000
2. Consulting services by AEC	500,000
3. Postconstruction R. and D.	500,000
4. Waiver of fuel rental	1,000,000
Total assistance	7,000,000

Further R. and D. assistance, in a total of $3,650,000, will be provided by the 10 neighboring utilities, who, with NSP are organized in a nonprofit corporation, Central Utilities Atomic Power Associates.

The reactor and associated power facilities will be wholly owned and operated by NSP and will be located on the NSP system near Sioux Falls, S. Dak.

The cost of the project, including research and development, fabrication and construction, is estimated at $28,800,000, as originally presented in 1957, and as included in AEC program justification data, arrangement No. 58–111–2. To this time we have found no reason to modify this estimate.

Work on this project was begun May 2, 1957, under a contract with Allis-Chalmers Manufacturing Co. This contract was confirmed November 22, 1957. Under the contract Allis-Chalmers will perform all research and development, pre- and post-construction, and will design, construct, and place the plant in operation. Substantial and satisfactory progress has been made under this contract.

The project is for a 66-megawatt electrical powerplant, to be in operation by June 1962. A controlled recirculation boiling water reactor, CRBR, light water moderated and cooled, will provide 164-megawatt heat. A superheater will provide 39-megawatt heat. It is expected, through the control of recirculation by variable speed pumps, to greatly increase the power output as compared to thermal recirculation, and so to reduce the reactor size and cost. Controlled recirculation will also control the reactor power, thus providing a control method in addition to the control rods. A second objective of this project is the development of a fuel element relatively low in first cost and processing cost.

The CRBR project is in its beginning stages. It is still too early for conclusions on any phase of the project. However, to this time it can be said that progress is satisfactory, that cooperation on the part of AEC has been excellent, and that nothing has developed which causes us to be concerned over either our cost estimate or progress schedule.

That completes my statement.

Chairman DURHAM. Do you have a firm contract with Allis-Chalmers?

Mr. HALL. Yes, sir.

Chairman DURHAM. For the amount of $27 million; is that correct?

Mr. HILL. That is not correct, no. The firm contract with Allis-Chalmers is for $20 million, which does not include the cost of the fuel elements. Those will be additional cost to Northern States Power Co.

Chairman DURHAM. Do you feel that you have made some progress?

Mr. HILL. Yes, sir. We are at such a stage now that we are on the verge of being able to draw conclusions.

If you were to ask me that question 3 months from now I could answer it much more firmly, but we feel that we are on schedule, that we are making progress, and that the progress being made is in accordance with the schedule generally that we have adopted almost a year ago.

Chairman DURHAM. You have a very good statement.

Mr. Jenkins, do you have any questions?

Mr. JENKINS. Whenever you say power elements—is that the word I understood you to say?

Mr. HILL. Fuel elements.

Representative JENKINS. How broad is that? What does it do?

Mr. HILL. I mean the reactor core in this case. That is in addition to the contract with Allis Chalmers that I mentioned, of $20 million.

Representative JENKINS. In other words, that is what will be left. It will be the reactor complete?

Mr. HILL. No; under the Allis Chalmers contract the reactor vessel and all its surroundings will be provided. Northern States will provide the fuel, as it were, for the reactor.

Chairman DURHAM. Mr. Hosmer?

Representative HOSMER. You describe this as an advanced type of reactor. Is the advanced portion in connection with the control mechanism?

Mr. HILL. The controlled recirculation.

It is in the first place a means of obtaining a greater capacity from a given size reactor.

Secondarily, it provides an additional means of control.

Representative HOSMER. Does that have to do with the fuel element?

Mr. HILL. The fuel elements enter into it to a degree, but the primary new feature is the use of pumps to circulate the water in the reactor. This stabilizes the reactor in such a manner that it is practicable to raise its capacity to the limit of the possible heat exchange.

It circulates the water through the fuel.

Representative HOSMER. But you did mention that you are to design a low first cost and processing cost fuel element?

Mr. HILL. Yes, and these fuel elements in addition to the recirculation feature are being experimented with under this program with a view to a reduction in cost of the fuel elements.

Representative HOSMER. All the engineering of the reactor, the research and development on that, is being done by AEC?

Mr. HILL. No, sir; by Allis Chalmers—you mean with AEC money?

Representative HOSMER. No. I thought perhaps some of this work was being done in AEC laboratories?

Mr. HILL. There will be some done in AEC laboratories, as we may request it. A part of the research and development allocation is an estimated $500,000 worth of work to be done in AEC laboratories and through consultation with AEC and so on.

Representative HOSMER. What temperature do you have?

Mr. HILL. The reactor temperature, that is the steam in the reactor, will be at 489°.

There is a superheater in connection with this reactor which will raise the temperature to 825°.

Representative HOSMER. That is a conventional superheater?

Mr. HILL. Yes, sir.

Representative HOSMER. What is the pressure?

Mr. HILL. Six hundred pounds in the reactor, about 500 at the throttle.

Representative HOSMER. Thank you.

Chairman DURHAM. Have you progressed to the point, or have you made any estimate as to the cost per kilowatt-hour?

Mr. HILL. Yes, we have, Mr. Durham. Our estimates remain as they were submitted with our proposal. The operating cost itself, not including fixed charges, we estimate at about 4.7 mills after we have operated the plant for a little while and have experimented with the fuel elements.

Chairman DURHAM. That is a very low cost of production.

Mr. HILL. That is only production cost. It does not include the fixed charges. The fixed charges added to this, if we include the total cost of the project, would raise the figure to slightly over a cent.

Representative HOSMER. Does that include or exclude the waiver of the fuel service?

Mr. HILL. The figures I am giving exclude waiver. That is after this experimental period.

Representative HOSMER. With fuel charges as they are now published?

Mr. HILL. Yes, sir.

Chairman DURHAM. I believe that is as low a cost as has been made as I recall.

Mr. HILL. That is our estimate for good or ill.

Representative HOSMER. What do you figure if you include your capital cost?

Mr. HILL. A little over a cent, but that is based on the capital cost of this first unit.

It is not too meaningful because the next unit we expect to build for a considerably lower price than this one.

Representative HOSMER. Will it have any increase in capacity?

Mr. HILL. It could be done but I was thinking in terms of the same size of unit, a duplicate of this plant sometime in the future.

Chairman DURHAM. What did you say the production per kilowatt-hour was?

Mr. HILL. About 4.7 mills.

Representative HOSMER. I mean the power production of kilowatts?

Mr. HILL. Sixty-six thousand kilowatts is the plant size.

Chairman DURHAM. That is a prety good size plant.

Mr. HILL. Yes, it is not, however, as large a plant as we would build normally in a conventional unit. We are adding to our system now 150,000-kilowatt-units normally.

Chairman DURHAM. The overall cost will be how much installed per kilowatt?

Mr. HILL. For the conventional plant?

Chairman DURHAM. Yes.

Mr. HILL. About $150 a kilowatt. This atomic plant will be in the neighborhood of $400 if we use the total cost.

Chairman DURHAM. Are there any further questions?

Representative HOSMER. This circulation in the reactor is induced by your pumps outside?

Mr. HILL. Induced by pumps outside the reactor in this case.

Representative HOSMER. Thank you.

Chairman DURHAM. Thank you very much, Mr. Hill.

The next witness is Mr. John W. Keen, manager of the Wolverine Electric Cooperative.

Mr. Keen, we are glad to have you, sir.

STATEMENT OF JOHN W. KEEN, MANAGER, WOLVERINE ELECTRIC COOPERATIVE, BIG RAPIDS, MICH.

Mr. KEEN. Mr. Chairman, thank you, I am very happy to be here.

I am John W. Keen, manager of Wolverine Electric Cooperative of Big Rapids, Mich.

I last appeared before this committee on June 18, 1957, at which time I advised you of our progress in attempting to negotiate a contract for the construction of a 10,000-kilowatt aqueous homogeneous reactor at Hersey, Mich., under the Commission's power demonstration reactor program. Our negotiations were being carried on as the result of our proposal of February 1, 1956, to the Commission. I closed my testimony on the hopeful note that our project would develop rapidly in the months to follow. However, this was not to be the case, for on July 25, 1957, I received the following letter from our proposed reactor designer and builder, the Foster Wheeler Corp. of New York City.

FOSTER WHEELER CORP.,
New York, N. Y., July 23, 1957.

Mr. JOHN KEEN,
Wolverine Electric Cooperative,
Big Rapids, Mich.

DEAR MR. KEEN: About 1½ years have elapsed since we submitted to you a proposal for a 10,000-kilowatt aqueous homogeneous burner reactor system. In view of the passage of time and in the light of new developments, we have considered it necessary to conduct a complete review of our proposal. This has now been accomplished, and two general conclusions can be drawn.

1. The technical section of the proposal is out of date to such an extent complete revision and reevaluation is required.

2. Current quotations on many items of equipment are so much higher than the original estimates of vendors that a complete revision of our price quotation is required.

For these reasons it is necessary for us to withdraw our original proposal and its revision. Further negotiations would have to be based on a new proposal and quotation. Technical revisions will in all probability make it necessary for you to revise some of your cost estimates.

Please advise us whether we should proceed with a new proposal.

FOSTER WHEELER CORP.,
JOHN CARTINHOUR,
Manager and Chief Engineer, Nuclear Energy Department.

On August 5, 1957, following discussions with Foster Wheeler, I forwarded a copy of their letter to Mr. Jon D. Anderson, Manager,

Schenectady Operations Office, Atomic Energy Commission. Mr. Anderson then arranged a meeting on August 21 1957, at the Washington offices of the Commission for the purpose of discussing the implications of the Foster Wheeler letter. Representatives of the Atomic Energy Commission, Foster Wheeler Corp., and Wolverine Electric Cooperative were in attendance.

At this meeting Mr. John Cartinhour of Foster Wheeler explained that although on January 15, 1957, they had made a revised firm quotation for their portion of the project in the amount of $4,890,000, a more recent detailed review indicated that their costs would reach $14,436,000; and further, that because of the many uncertainties associated with this program, Foster Wheeler could not enter into a closed-end contract even at that price. He also stated that Foster Wheeler would consider a contract for this project on a cost basis.

Immediately after this meeting the following telegrams were dispatched:

AUGUST 21, 1957.

UNITED STATES ATOMIC ENERGY COMMISSION,
Washington, D. C.:

(Attention: W. K. Davis)

Reference Wolverine project Foster Wheeler's original quotation to Wolverine January 1956 was $3,788,000. Revised quotation on January 15, 1957, was $4,890,000. Current estimate of project cost is $14,436,000. Increase in cost is attributable to technical uncertainties and a disproportionate rise in the cost of all components to be supplied by Foster Wheeler and its vendors. In view of these uncertainties Foster Wheeler must withdraw its original proposal as revised on January 15, 1957, and cannot undertake the Wolverine project on other than a cost basis. Please advise if this is acceptable.

JOHN CARTINHOUR,
FOSTER WHEELER CORP.

Copies of this telegram were also sent to United States Atomic Energy Commission, Post Office Box 1069, Schenectady, N. Y., attention: J. D. Anderson, and to Mr. John Keen, Wolverine Electric Cooperative, 302 South Warren Street, Big Rapids, Mich.

AUGUST 21, 1957.

UNITED STATES ATOMIC ENERGY COMMISSION,
Washington, D. C.:

(Attention: W. K. Davis.)

Reference our proposal of January 1956 for construction of aqueous homogeneous reactor our reactor builder Foster Wheeler Corp. has advised us with copy to you that technical uncertainties and disproportionate component cost increases have necessitated their withdrawal of firm revised quotation of January 15, 1957, in amount of $4,890,000. They further advise they can proceed with project only on cost basis with current estimate their cost $14,436,000. In view of these circumstances Wolverine requests your advice as to whether or not Commission would consider revision of our proposal on a cost basis.

JOHN KEEN,
Manager, Wolverine Electric Cooperative.

A copy of this telegram was sent to the United States Atomic Energy Commission, Post Office Box 1069, Schenectady, N. Y., attention: J. D. Anderson.

On October 7, 1957, I met in Washington with representatives of the Atomic Energy Commission and was advised that the Oak Ridge National Laboratory had been requested to conduct studies and prepare cost estimates of a complete reactor system similar to the Wolverine proposal to be constructed at the Wolverine site. I was also

advised that the Commission was desirious of obtaining approximately 2 months operating experience on HRE No. 2 at Oak Ridge in connection with this study. During the second week of December, I was informed that the construction cost study had been completed and that the figures appeared to be favorable. However, it is my understanding that the operational data on HRE No. 2 is not yet available.

Wolverine became actively interested in exploring the Commission's power reactor program in February of 1955 in the belief that the development of economically feasible small reactors was vital to many facets of our national life. We further believe that the feasibility of such reactors can best be demonstrated when they are operated as independent installations subject to the day-to-day circumstances of normal utility operation and not as laboratory curiosities.

It is unfortunate that although a tremendous amount of work has already gone into this project there is so little to indicate that a small demonstration reactor of this type will be constructed for civilian application in accordance with the intent of the power demonstration reactor program.

Chairman DURHAM. Well, you are out of business, are you, Mr. Keen?

Mr. KEEN. Since we compiled this written testimony we have had another meeting with the representatives of the Atomic Energy Commission. They have exposed to us additional studies over and above what they had in December.

They also indicated that the HRE No. 2 at Oak Ridge, even though it was intended to go on the line, or to become critical approximately 2 years ago, it is still in a developmental stage where they are correcting failures of some of the component parts.

Chairman DURHAM. At the present time you are still trying to get a contract to build one; is that correct?

Mr. KEEN. Not necessarily, no.

Since July 25 when we requested the Atomic Energy Commission to advise us on what steps to follow, or what procedure they might recommend, the contract negotiations have been dormant.

Chairman DURHAM. Are you pursuing any project at the present time, trying to get a contractor?

Mr. KEEN. We are not working on an actual contract as of today, although it is our personal feeling that at this time it appears that the homogeneous burner type reactor is not ready to go out into civilian application.

Chairman DURHAM. Primarily due to the cost of it?

Mr. KEEN. Not so much the cost of the reactor itself, but the expected operating cost of the reactor.

Chairman DURHAM. Had you already had in being your financing when this contract was let to Foster-Wheeler Corp.?

Mr. KEEN. As you note, they changed their quotation to us, at one time raised it and then they came back in July 1957 and requested consideration of another increase, but not on a closed-end contract, but on an open end or on a cost basis.

They would not consider a closed contract.

Chairman DURHAM. What was the total cost of it when it was first projected? Did you make any estimate of cost or was it left entirely up to Foster-Wheeler?

Mr. KEEN. Foster-Wheeler, of course, as you know, has a substantial history in the manufacturing of component parts of the reactor field, and they submitted a proposal to us of something over $3 million to design and construct on our site this reactor. We, of course, would furnish the conventional equipment for the reactor such as the site, the electrical equipment, the superheater boiler, the electrical and switch gear, the operator personnel, and so forth.

Then they came back in January 1957 and requested a revised contract in the amount of $4,890,000.

Chairman DURHAM. Which you agreed to?

Mr. KEEN. Which we agreed to and which the commission agreed to.

Chairman DURHAM. But when they went to the $14 million, why, you did not agree to that?

Mr. KEEN. We did not agree to that, though. We did not agree to it because a reactor project in the field has to have some hope of eventually becoming competitive with fossile fuels, otherwise we would not be interested in it.

If there were no hopes of it becoming competitive we would have no particular interest.

However, there are some proven types of reactors that some people do believe that might need further development in the smaller range class, say up to 20 or 30 megawatt size, that could be very advantageously developed out in the field.

Chairman DURHAM. Did you make any projected cost per kilowatt hour on the final bid of $14 million?

Mr. KEEN. I cannot furnish you that information, but I can furnish you one that is perhaps more concrete than anything we could do. That is a tabulation of estimates that were worked up by some of the personnel at Oak Ridge. It ties in with this December report that they submitted to the commission.

Chairman DURHAM. Well, give us that, if you have it, for the record.

Mr. KEEN. The reason for our becoming disinterested in the aqueous homogeneous reactor at this time is basically due to the findings that were developed at Oak Ridge.

Chairman DURHAM. I am just running the figures through my head. A 10,000 kilowatt plant costing $14 million would be about $1,400, or close to it, per kilowatt installed capacity.

Mr. KEEN. That is very true, and that is very discouraging. However, when you are making a pilot plant, the first model, you can expect naturally that the construction costs are going to be high.

Chairman DURHAM. I do not know of any estimate in the whole category of reactors that runs that high.

Mr. KEEN. The information that the boys at Oak Ridge came up with was about $9 million for this project, as far as construction costs were concerned.

Chairman DURHAM. About $5 million less than what they offered to build it for?

Mr. KEEN. That is right.

Chairman DURHAM. That is still pretty high.

Mr. KEEN. Of course, you must realize in the aqueous homogeneous reactor you have much more than a reactor system. You have the chemical processing plant where the fuel is reprocessed on the site which can bear a lot of merit in future development for isolated plants can be practically self-maintained without having too much external communication.

Chairman DURHAM. Has there been any action taken by your group of directors or whatever you call them as to where they go from the present status of things?

Mr. KEEN. You mean the directors of Wolverine.

Chairman DURHAM. Yes.

Mr. KEEN. The Wolverine directors just recently charged me with the responsibility of continuing our interest in the reactor program so that in any way we can benefit the program they are willing to do so.

Chairman DURHAM. You are still authorized then to negotiate with AEC for a proposal?

Mr. KEEN. That is right, sir.

Chairman DURHAM. Are there any questions?

Representative HOSMER. Mr. Keen, how much money does Wolverine have in this thing so far?

Mr. KEEN. I am sorry; you embarrass me. I cannot give you a definite answer on that.

Representative HOSMER. It is all in negotiating, nothing in technical work?

Mr. KEEN. That is right. This is purely an estimate.

I have seen some figures recently, but there was other developmental work in this of a smaller nature, about $35,000 to $38,000 that Wolverine has directly expended for the negotiation of the contracts and working up the proposal that we submitted in February of 1956, although I do believe that there is a substantial amount of engineering cost that is not in the $38,000 figure.

Representative HOSMER. Were you here when the Pennsylvania Power & Light people were testifying?

Mr. KEEN. I was not.

Chairman DURHAM. I do not believe you gave us whether or not you already arranged your financing for the conventional part of the plant.

Mr. KEEN. For the conventional part of the plant, the financing has been arranged by Wolverine some time ago.

Chairman DURHAM. What was the cost of that, do you recall?

Mr. KEEN. We requested and received a loan from the Rural Electrification Administration of a little over $3 million. The bulk of that was for the conventional part of the plant, but there were some other related capital investments also, some transmissions.

Chairman DURHAM. Can you get the loan?

Mr. KEEN. The loan is available.

Chairman DURHAM. Did you ever get it in hand?

Mr. KEEN. We have not requested the loan advance yet.

Of course, REA is like any other banker. You have an idea, but you have to submit to them certain evidence that you are——

Chairman DURHAM. You have not committed yourselves against the loan so far as buying equipment is concerned?

Mr. KEEN. We have placed no orders; no, sir.

Would you like these operating estimates costs that were worked up?

Chairman DURHAM. Yes.

Mr. KEEN. By charging 15 percent for amortization——

Chairman DURHAM. Is that the normal chargeoff?

Mr. KEEN. That is a normal chargeoff for a private utility. That is very high for a cooperative that is borrowing money for 2 percent interest.

We feel that about 7 or 8 percent is closer to our particular position than 15 percent, but the Oak Ridge people used 15 percent.

Of that, the capital depreciation costs were 18.72 mills.

Let us cut it down to our size. That would still be half of that, or 9 mills as far as capital investment is concerned. That along with the fuel burnup, inventory, other processes, maintenance and operation, brings it up to an estimated cost of 22 mills per kilowatt-hour.

So you can see it is very discouraging at this time as far as the aqueous homogeneous burner type reactor to be submitted to the field.

Chairman DURHAM. I do not understand why you are pursuing it.

Mr. KEEN. If we took the complete 18 mills out, the complete capital investment out of there, we would still have a cost which no one could live with, in the general area which we are serving.

The reason why we are here today is by the request of the committee to bring you up to date from our last testimony to you.

Chairman DURHAM. We are glad to have it, of course.

Mr. KEEN. However, we do feel that there are other types of reactors that show a tremendous amount of promise in the small reactor field and there should be certain developmental work done and proven out in the field beyond the laboratory stage now where they can be taken out in the field.

Chairman DURHAM. Pursuing another approach.

Mr. KEEN. That is correct. But I do not know whether the Commission has the authority to change the approach on the second round which we are concerned with, the second round of reactor proposals or not. That is a question we do not have the answer to.

But if it could be worked out so that the Commission would have authority to either accept a different approach or a new round brought into the picture, where everything has been learned from the teams that have been working on these various projects for the last few years, put their resources together on a so-called fourth round, it is our belief that a tremendous amount of benefit could be derived from that.

Chairman DURHAM. On whose advice did you get into this, on the basis of the directors' request? How did Wolverine get into it?

Mr. KEEN. In 1955—I am quite sure of this date but I would not want to be held to it—the board of directors of Wolverine requested our engineering firm and myself to make a thorough investigation into the atomic energy field to determine whether or not there was any part that Wolverine could play in the development of the reactor industry.

Chairman DURHAM. Did you have the advice of engineers or reactor experts, or did they just do it on their own initiative?

Mr. KEEN. They did it on their own initiative. However, we feel that we had many things to offer, particularly our location; that is

of benefit to the Atomic Energy Commission and to the advancement of the art, that is not found just anywhere and everywhere.

We are in a relatively high fuel cost area, one of the higher fuel cost areas of the Nation.

Chairman DURHAM. Do you mind disclosing the figures, the profit the corporation made last year?

Mr. KEEN. Our corporation last year showed a slight deficit. It did not make a profit last year.

Chairman DURHAM. It showed a deficit?

Mr. KEEN. That is right.

Chairman DURHAM. I believe the year before you showed a slight profit.

Mr. KEEN. We showed a profit of $18,000. Of course, you understand that one of the problems of management of a rural electric cooperative is attempting to budget and recommend to the board for proper board action so that you come out near the zero margin.

Chairman DURHAM. I understand that.

Are there any further questions?

Representative HOSMER. There is one question that came to my mind while you were interrogating Mr. Keen.

In connection with your continued interest in atomic power, you were up to about a $5 million deal. You would not be interested in one that was much higher than that?

We know that the $14 million deal is out of your range. Just where is your limit?

Mr. KEEN. I could not say where the limits were. That would be rather difficult to express as a statement.

Representative HOSMER. It would be probably closer to 5 than to 14.

Mr. KEEN. That is correct.

However, we were pleased and rather satisfied with the $9 million figure that Oak Ridge came up with in December.

Representative HOSMER. When this thing began did Foster-Wheeler get hold of you, or did you get hold of them?

Mr. KEEN. Foster-Wheeler originally contacted us.

Representative HOSMER. Thank you.

That is all, Mr. Chairman.

Chairman DURHAM. Thank you very much, Mr. Keen.

The next witness is Mr. David B. Sloan, president of Gibbs & Hill, Inc.

Mr. Sloan, will you come around, please.

STATEMENT OF DAVID B. SLOAN, PRESIDENT, GIBBS & HILL, INC.

Mr. SLOAN. Thank you, Mr. Chairman, I appreciate your giving me this opportunity today.

I would like to address myself to item 5 in the suggested topics for discussion which was forwarded with your invitation of January 20, which is AEC contract policy.

Chairman DURHAM. All right, you may proceed.

Mr. SLOAN. Thank you, sir.

My name is David B. Sloan, and I am president of Gibbs & Hill, Inc. While Gibbs & Hill, Inc., has been engaged in the atomic-energy field for a number of years, this is the first occasion on which anyone representing the firm has appeared before the Joint Committee

on Atomic Energy. I am, however, pleased to have this opportunity to appear before you to comment briefly on the role of the independent architect-engineer in atomic-energy work as we see it today. The term "independent" means that we hold no proprietary interests in materials and equipment and are not compromised by the necessity of meeting a fixed price in construction operations. By architect-engineer we mean a firm engaged for engineering services which is prepared to render minor architectural services incidental to its engineering.

Primarily, we would like to emphasize today what we see as the important functions to be discharged by architect-engineers in nuclear power work. Furthermore, the high importance of these functions prompts us to comment on some of the difficulties faced in discharging them.

In assessing the role of the architect-engineer in nuclear power development, it is probably worthwhile to note briefly how his responsibilities have evolved in recent years. In the field of conventional powerplant construction, it is fairly well understood that the proper and desirable role for an architect-engineer is first to determine the overall technical and performance requirements needed in the new plant. These are translated by the architect-engineer into a general plan for the plant, a detailed layout of equipment, and into specifications for the various items of equipment which are procured by the client or by the engineer in his client's behalf and installed in new structures designed by him and perhaps constructed by him to provide a complete installation ready for operation by the client. In handling these tasks the engineer's primary purpose is to produce a finished plant representing the best economic combination of equipment and materials obtainable, considering both initial investment and lifetime operation.

Because of the manner in which the use of nuclear energy developed, the organization of work on nuclear power projects has until now followed a somewhat different pattern. Technology governing the use of nuclear energy and for power purposes originated, of course, with the scientists in their laboratory research and development. A few years ago, when it became apparent that the time had come to convert nuclear energy into useful power generation on a larger scale, the first step was to engage the more experienced reactor system manufacturers to undertake the development and engineering design of reactor plants of an experimental character. The reactor system designers, in turn, divided the projects into a series of analytical studies and developmental projects on materials and components. And they have generally undertaken also the problem of overall system layout and design. Generally speaking, when it became necessary to handle questions of site location, site utilities, and general structural design, architect-engineering firms were brought into the picture. Gradually, as more projects have been undertaken, and as greater initiative and responsibility have been assumed by private utility and manufacturing organizations, the responsibilities of the engineers in nuclear power work have tended to increase and to approach more nearly the normal scope of responsibilities found in other types of powerplant work.

We, like other engineering firms, have anticipated that our responsibility in the nuclear power field would eventually become very much

the same as it now is in conventional plant engineering and construction, and we have taken steps to prepare ourselves by training and experience for handling this responsibility. Engineers from our staff have been made available for formal training at reactor schools of the Atomic Energy Commission. We have employed engineers with nuclear power experience or training and provided supplementary training for other engineers on our staff, so that today we have at hand a core of executives and engineers who have special qualifications for work in the nuclear power field. Many other engineers from our normal engineering complement are able to perform important technical functions closely related to nuclear power work.

Along with this program of building the competence of our staff, it has been the privilege of our firm to serve both the United States Atomic Energy Commission and major industrial organizations in the nuclear field going back as far as 1950. Engineering services have been rendered on electrical transmission lines and substations at the National Reactor Testing Station for the Idaho operations office; for all utilities at the Savannah River plant for the Savannah River operations office; for various supporting facilities required by the S3G installation at West Milton, N. Y., for the Schenectady operations office; and currently for the Princeton University-University of Pennsylvania proton accelerator at Princeton, N. J., for the New York operations office. In response to invitations, qualification statements have been submitted for a number of other projects over the years. I would also point out our active engagement in nuclear power work abroad. Our firm has been fortunate to have been engaged in general engineering and supervision of electrical powerplant construction in South America, Europe, and the Far East since the end of the last war. This work has gone on almost continuously, covering up the 10 different countries and over 1,500,000 kilowatts of installed capacity. It was logical, therefore, that one of our foreign clients should retain us for a nuclear powerplant when they became interested in this new form of energy. Similarly, we have been retained by one of our large manufacturers to assist in the design of a nuclear powerplant in Europe. This work helped to develop and strengthen our experience in the nuclear power field. And in keeping with our regular practice, we have made maximum use of local resources and provided important training for foreign engineers involved in the design and subsequent operation of these facilities.

We are now more than ever convinced of the basic need for the type of services which the architect-engineer traditionally renders. It is known that many of the most serious problems in the development of nuclear power arise in the nonnuclear components and mechanical features of reactor projects. A number of other factors, which bear on the ultimate economics of nuclear power, depend to a great extent on straightforward engineering improvements more than on subtle questions of nuclear physics. This is not in any sense to discount the problems of the nuclear physicist which we fully appreciate will be basic to advancement in this field for many years to come. There are, however, still other questions arising from site selection and the effect of site conditions on plant construction which are a part of the normal civil engineering responsibilities of the architect-engineering organization. Finally, in this brief résumé, I should men-

tion the importance of coordination of job-site construction with design and procurement of materials and equipment. In consequence, we urge that the AEC and the reactor builders continue to broaden the use of independent engineering organizations in the many phases of nuclear plant work where their experience is already of value. Further, qualified architect-engineers should be aided to learn their tasks by doing them, just as design organizations and manufacturers are learning theirs.

Having thus considered the role of the architect-engineer in nuclear power work, let me comment on some of the problems affecting the incentives offered the architect-engineer in this field today. Our cumulative experience with a variety of work for the Atomic Energy Commission has left us with some impressions which are disturbing to us as a professional engineering organization; and in a larger sense disturbing from the standpoint of their effect on the overall atomic energy effort. One impression has to do with certain specific effects of the application of the Commission policy of "spreading the work" through, in general, denial of consideration to any firm which is already engaged in engineering services to the Commission on projects having a construction value exceeding $2 million. We understand well enough the basic purpose of such a policy. We point out, however, that it is just as important from the standpoint of the total atomic energy effort to develop know-how in engineering firms as it is in manufacturing and utility organizations. Consequently, if through application of this rule, an organization through involvement in an Atomic Energy Commission contract of nominal size, over $2 million, which stretches out over 3 or 4 years, is denied any opportunity during that time of being considered for nuclear power projects, regardless of their qualifications relative to other candidates for the work, the consequences, in our judgment, might be serious and undesirable. We urge that such rules be applied with great discretion, recognizing the cardinal importance of developing know-how in organizations whose competence will be important in the future of nuclear power development both in this country and abroad.

Our second point has to do with the handling of unallowable costs in overhead reimbursement on cost-plus-fixed-fee contracts. It is our understanding that in such contracts for engineering services the fee is related to the construction cost of the facility and, in some instances, we feel insufficient recognition is given to the complexity of the engineering services as reflected in the magnitude and nature of the manpower requirements. Thus, to cite a specific example, where the Atomic Energy Commission estimated the construction cost to be $11 million, the fee acceptable to the Commission was indicated to be $93,000. At the same time, the Commission's estimate of engineering manpower requirements was 26,000 man-days, which would result in a salary cost to Gibbs & Hill, Inc., of perhaps $900,000 for technical salaries. Our indicated overhead corresponding to such direct cost would be in the order of $500,000. Under AEC policy, about one-third, or $167,000, of the overhead is made up of unallowable costs. It is thus evident that the fee of $93,000 would fail to cover disallowed overhead by $74,000, resulting in a loss to the firm of this amount. It might be argued that the estimated overhead is too high, but we are convinced that the overhead relationship conforms with the general

experience of the profession, and would point out that, percentagewise, it is well below the amount considered as necessary in the fee schedule of the American Institute of Consulting Engineers.

Another recent experience also relates to the use of the Commission's fee schedule on cost-plus-fixed-fee contracts. Under the terms of the contract on which we were engaged, through inadvertence certain overhead items not normally allowable had been accepted. As a result of a final audit to determine the actual overhead experience, this situation was called to the attention of the operations office involved. Our position was that any items of overhead unacceptable to the Atomic Energy Commission as such should be added to fee. We were told, however, there was no possibility of doing this, because under the Commission's criteria for determining such fees no increase was possible. It then became quite evident that with the overhead items restricted to those allowable by the Commission, and the fee unchanged, we had again failed to cover our normal overhead costs. Continuance of this kind of policy on reimbursement might, in our opinion, ultimately result in preventing reputable firms from acquiring such job experience as may be available through the Atomic Energy Commission's own direct contract work.

In citing these experiences, with their implications, it should be distinctly understood that we are not being critical of a particular operations office or particular staff members. These problems, we feel, are a consequence principally of the unusual origins of atomic energy work and the policies which resulted therefrom. We are well aware that in the early days the value of the Commission's know-how was so great that it was considered to have a value which would to some extent offset the relatively low fees and restrictive reimbursement practices of the Commission. As of now, because of the high degree of experience and initiative in private organizations as well as the Government, we wonder if it is still appropriate for the Commission to employ the remainder of the Government's monopoly of information as justification for practices which in a number of instances do not result in adequate compensation for services rendered.

In short, we feel the place of the independent architect-engineer is of marked importance to the future of nuclear power because of his independent point of vew, his primary concern for the economic interests of the owner and plant operator, and because of his long practical experience with most plant features outside the reactor core. Hence, we urge that qualified powerplant engineers be encouraged to participate in nuclear power work so as to assume normal responsibility in this field as early as possible.

We thank you for this opportunity to express our views and hope that they will be helpful in your consideration of how best to make use of the technical resources of our country.

Chairman DURHAM. Thank you very much, Mr. Sloan.

You do not take any contracts; you are just a service organization to the contractor?

Mr. SLOAN. That is right. We are purely a professional engineering organization.

Chairman DURHAM. How large is your company?

Mr. SLOAN. A total of 500 personnel.

Chairman DURHAM. How long have you been in business?

Mr. SLOAN. Since 1911.

Chairman DURHAM. You should have a lot of experience. I have some questions on the restrictive $2 million. As to that, of course, you know the primary purpose, I suppose, is to try to spread the work. I kind of agree with you that where the people are qualified I do not think there should be any restriction.

If they have the ability to do the job, and do not get the job done, you have to have somebody to do it, whether it is a $2 million or $25 million job.

Have you actually had experience with that, a $2 million contract with AEC?

Mr. SLOAN. We have been advised that we could not be considered for a particular project because of the volume of AEC work we had in hand at that time.

Chairman DURHAM. That is not generally true in other Government agencies, is it?

Mr. SLOAN. Not to my knowledge; no, sir.

Chairman DURHAM. The Defense Department does not have any such restriction?

Mr. SLOAN. Not so far as I know.

Chairman DURHAM. Do you do any work for them?

Mr. SLOAN. We have done work for the Navy.

Chairman DURHAM. Are there any questions?

Mr. Price?

Representative PRICE. You have been in business since 1911, Mr. Sloan, but how long have you been doing business in the atomic-energy program?

Mr. SLOAN. Since 1950.

Representative PRICE. I do not notice your home address, your firm. Where are you located?

Mr. SLOAN. Pennsylvania Station, New York. We also have an office in Los Angeles and one in Tampa.

Representative PRICE. Do you deal directly with the Atomic Energy Commission, or do you deal mostly with contractors with AEC?

Mr. SLOAN. Primarily with the prime contractors. On the Savannah River operations, which were mentioned in my statement, our contract was with Du Pont. Du Pont held the prime contract with the Commission.

Chairman DURHAM. Did you do all the engineering work there?

Mr. SLOAN. All the utilities, the water supply, sewers, electrical supply, steam distribution, things of that sort.

Representative PRICE. Have you done any design engineering on any processing plant?

Mr. SLOAN. Did we do any design work on the processing plant at Savannah River? No, sir.

Chairman DURHAM. Mr. Hosmer?

Representative HOSMER. I have a question with respect to the $2 million restriction on the volume of work you can do for the Atomic Energy Commission.

Is it a fact that you are not actually doing nuclear power work, as such, but it is more or less conventional work, powerlines, substations, and all?

Mr. SLOAN. That is right.

If I might add our conception of our place in the nuclear-power field, we do not presume to be, and we do not intend to become, designers of reactors.

Representative HOSMER. You are not learning anything you do not already know, doing that kind of work?

Mr. SLOAN. Yes; we are. Some of our work is actually in the design of the reactor vessel and its supports of the primary loop, many such things that are closely identified with the reactor.

Representative HOSMER. You are engaged in that work?

Mr. SLOAN. Yes, sir.

Representative HOSMER. Domestically or with the foreign companies?

Mr. SLOAN. We are particularly involved in it in the work we are doing for one of our large domestic manufacturers on the design of a small nuclear powerplant to be built in Europe.

Representative HOSMER. Is this an AEC job?

Mr. SLOAN. No.

Representative HOSMER. I am trying to tie this down to this $2 million limitation you are complaining about.

So far as I can see, it has been applied to you only as to more or less conventional type operation.

Mr. SLOAN. That is right, Mr. Hosmer.

Representative HOSMER. You really cannot complain that it is not allowing you to gain special nuclear power knowledge because it has nothing to do with that.

Mr. SLOAN. I think it does. For instance, Mr. Hosmer, on some work that we did for General Electric Co., known as the S–3–G, which is a submarine prototype reactor, whereas we were not involved in the reactor design, we were involved in the fuel handling, the waste treatment, and many of the features which derived from the fact that a reactor was involved.

Representative HOSMER. I am not trying to argue with you. I just do not want the record to go with the assumption that you were inside the reactor itself.

Mr. SLOAN. I would like to make it very clear that we do not presume or propose to become designers of reactors. We feel that is a manufacturer's function just as the design of any other form of steam generator is.

Chairman DURHAM. The installation of this type of equipment installed for the use of these reactors is a little bit different from the conventional type plant although it may be somewhat similar in operation.

Mr. SLOAN. That is the point I was making. If a reactor is involved as a steam generator, then there are many facilities which are necessary which are not required in a conventional plant about which we learn by performing those services.

Chairman DURHAM. For instance, if you design a waste disposal unit that is something different from what you have in an ordinary steam plant.

Mr. SLOAN. That is correct.

Chairman DURHAM. I believe you are the first engineer that has appeared before us, or company of engineers.

Are there any further questions?

We are glad to have had you because we want to have all sides of the picture.

Mr. SLOAN. Thank you very much, sir. We appreciate the opportunity.

Chairman DURHAM. The committee is adjourned until Monday morning at 10 o'clock, in this room.

(Thereupon, at 3:05 p. m., Friday, February 28, 1958, the committee was recessed, to reconvene at 10 a. m., Monday, March 3, 1958.)

DEVELOPMENT, GROWTH, AND STATE OF THE ATOMIC ENERGY INDUSTRY

MONDAY, MARCH 3, 1958

CONGRESS OF THE UNITED STATES,
JOINT COMMITTEE ON ATOMIC ENERGY,
Washington, D. C.

The Joint Committee met at 10 a. m., pursuant to recess, in room 1334, New House Office Building, Hon. Carl T. Durham (chairman of the committee) presiding.

Present: Representatives Durham, Price, and Hosmer.

Present also: David R. Toll, staff counsel, and George E. Brown, Jr., and Richard Smith, staff members.

Chairman DURHAM. The committee will come to order.

The first witness this morning is Mr. Gravgaard, president of the Rural Cooperative Power Association of Elk River, Minn.

STATEMENT OF O. N. GRAVGAARD, PRESIDENT, RURAL COOPERATIVE POWER ASSOCIATION

Mr. GRAVGAARD. Thank you.

Mr. Chairman, we have submitted a very condensed report to this committee. However, with 3 years of negotiations with the Atomic Energy Commission and others, I am sure that if there is anything beyond what we have submitted here in our statement that you wish to ask, I am sure that we will be able to answer.

I think that our manager, Mr. Walters, has become quite a professional in the atomic energy field, and I am sure that he will be able to answer any questions that you wish to put to him.

Do you wish this statement?

Chairman DURHAM. Yes, if you do not mind reading the statement.

Mr. GRAVGAARD. I will ask our manager to read it, and if he wishes to comment on any phases of it, I hope he will be permitted to do so.

Mr. WALTERS (reading):

Mr. Chairman, I am O. N. Gravgaard of Hawick, Minn., president of the board of directors of Rural Cooperative Power Association, Elk River, Minn. I am pleased to accept the committee's invitation to come here and report to you on the present status of our reactor plant.

Unfortunately, soon after my last appearance here our first proposer, the A. M. F. Corp., withdrew their proposal and decided to get out of the power reactor business.

This sudden development gave us great concern. Most of the conventional equipment, which RCPA is to furnish, had been ordered and will be received beginning in May of this year. This was necessary to meet the original reactor schedule of operating in June 1959. It also meant that our steam source to run the turbine would be delayed approximately 2 years, while $2½ million worth of conventional equipment stood idle. The delay also meant that the electricity

needed to supply our farm members' increasing requirements would not be available.

These factors have influenced our present decision to put in a conventional boiler to fill the gap until the reactor is completed, and it will serve as standby and emergency service until the reactor has achieved steady operation. Our load growth studies indicate we must add an additional steam turbine about 2 or 3 years after the reactor begins operation.

We are confident that the reactor will eventually produce more power than its initial rating. Recognizing this good possibility of more capability, and that several years' operation will prove dependability, the next turbine will be sized to the reactor's greatest capacity and the reactor will be depended upon as firm steam supply.

Shortly after A. M. F. withdrew, the AEC issued a request for new proposals. Six firms indicated interest, but four of these withdrew. The two remaining are the ACF Industries and General Electric Co.

RCPA personnel have cooperated in preparing information, drawings and other details needed by manufacturers in the preparation of their proposal. They are also working with the AEC evaluation staff going over the details of the two proposals in an attempt to make a selection of the best proposal.

Since the selection has not yet been made, and evaluations are still in progress, I would prefer to discuss the proposals only in general and leave the details and cost for announcement by AEC.

Both proposals indicated a willingness to construct a plant under a cost-type contract having a maximum limit similar to one RCPA had negotiated with AMF. Both reactors are boiling water types and appear to have some major improvements in fuel element design and handling over the original AMF reactor.

Our association had previously approved a letter of agreement with AEC as to general contract terms to cover the operation and financing of the plant. Only minor changes have developed since that time, and we look forward to early submission of both contracts to your committee.

In closing, I wish to convey my fellow directors' and my own apologies to your committee for the delays caused by our former contractor's withdrawal from a development program we both want to see move forward.

We wish to continue this project, and build the nuclear plant we started on several years ago. We hope your committee will give its continued support and help. Our people will do their best to make this a project we will both be proud of.

Chairman DURHAM. Thank you very much. Then you are in the position at the present time of going ahead and building a conventional steam-type plant?

Mr. WALTERS. We are adding the boiler to it. We had proceeded to build the conventional facilities because of meeting the other schedules of the other reactor. This changes the construction by approximately 2 to 2½ years before the reactor will be available to serve the facilities we are installing now. So, by putting the boiler in now, we carry our electric system until the reactor starts operating, and beyond that time the boiler then becomes a standby source of steam while the reactor is in experimentation, start-up, and during its shakedown period.

Chairman DURHAM. How do you think you are getting along with your negotiations with the AEC?

Mr. WALTERS. The proposals were received on February 3. This makes approximately one month in evaluating these two proposals. We have been here in the past for several days just prior to the snowstorm working on evaluating the two projects. Our men have been back in here for the last couple of days going over them further. We sincerely hope that before the next few days pass we are pretty close to saying which one of these companies it should be.

Maybe that is being a bit optimistic, but we are looking forward to an early completion of this selection.

Chairman DURHAM. Under the present conditions, I do not see much use of going into the cost details in the hearing, because you are not in a position to give us that information.

Mr. WALTERS. It would be embarrassing for us to talk about these costs until all of the analyses have been completed.

Chairman DURHAM. If that is completed before we get to the power hearings part of the 202 section hearings, which have been postponed, we might ask you to come back here if the proposal is finalized.

Mr. WALTERS. We would be pleased to discuss the selection and why it was made. It should be by that time.

Chairman DURHAM. Mr. Hosmer, do you have any questions?

Representative HOSMER. I have no questions, Mr. Chairman.

Chairman DURHAM. Thank you very much.

The next witness this morning is Mr. J. B. Thomas and Mr. H. R. Hallock, of the Texas Atomic Energy Research Foundation.

STATEMENTS OF J. B. THOMAS AND H. R. HALLOCK, TEXAS ATOMIC ENERGY RESEARCH FOUNDATION

Mr. THOMAS. Thank you, sir.

Chairman DURHAM. Mr. Thomas, we are glad to have you with us. I believe you are the company that is working with the AEC in the thermonuclear field; is that correct?

Mr. THOMAS. Yes, sir.

Chairman DURHAM. You may proceed with your statement.

Mr. THOMAS. Very well, sir.

My name is J. B. Thomas. I live at Fort Worth, Tex. I am vice president of the Texas Atomic Energy Research Foundation and appear here as its representative. I am a mechanical and electrical engineer with long experience in the design and construction of electric generating stations, and have been since 1941 president and general manager of the Texas Electric Service Co. serving Fort Worth and a substantial portion of west Texas.

The Texas Atomic Energy Research Foundation was organized in April 1957 by 11 of the 12 investor-owned electric utility companies operating in the State of Texas. These companies have a combined electric utility plant investment of nearly $2 billion, and have an aggregate generating capacity in excess of 6 million kilowatts, or approximately 5 percent of the Nation's total.

These companies, although operating in an area of natural gas and oil production and having advantage of relatively low transportation costs on fuel, nevertheless realize the challenge of not only keeping up to date with, but of aiding in the development and use of atomic energy for generation of electric power. They intend to keep in the forefront of research and development in this art so that it can be applied in our area whenever the interests of customers and investors justify doing so.

Our investigations soon developed that in spite of the accomplishments of those who originated and put together the atomic bomb and the hydrogen bomb and the processes for supplying their various elements, and in spite of the early developments in the use of atomic energy for electric generation, there is a great field of knowledge to be explored; that there must be generated a new field of scientific

knowledge and a new art, and that no man could say today that he knew the only way, or the best way, to make progress in these developments. Looking about for the way in which our research might be most effective, we decided that the fusion process, or in other words the taming of the hydrogen bomb reaction, offered the greatest challenge for our group. The possibilities of an unlimited source of energy from the ocean, of a relatively safe process with little energy in process at any moment, and a process with few if any dangerous waste byproducts to challenge our skill in disposing of them safely, confirmed our belief that this area of research was well worth getting into.

After studying the various ways of implementing this decision we arrived at an agreement with General Atomic, a division of General Dynamics Corp., having underway the construction of a great research laboratory at La Jolla, Calif. We found that they had initiated early in 1957 some experiments in the fusion process, that they had recruited and were continuing to recruit a group of fine scientists from this country and abroad to work on nuclear problems, including several outside consultants of national reputation, and that many of these men were devoted to the possibilities of the controlled thermonuclear reaction. We agreed to participate in the work already started and made an agreement for a 4-year, $10 million research program in which our group and the General Atomic group share equally in cost. We have watched the construction of the apparatus, we have visited with the engineers and scientists who are working on it, and have seen tangible evidence of the enormous forces that are involved and the progress in containing and directing them. We realize that continued research and experiment for many years will be required before ever we can reproduce the pressures and temperatures needed and control this reaction to serve our Nation and our people.

We are particularly proud that this research undertaking is carried out wholly by private capital. With the knowledge already developed in the United States and with the progress already being made in the types of mechanism which may be successful, we hope for continued progress. For our group, I want to say that it is our purpose to cooperate within and without our industry, and certainly with the committee and the Commission, and to make available our skills and experience and equipment in any reasonable way.

There will be presented to you today by the chairman of the Edison Electric Institute's Committee on Atomic Power, of which I am a member, a statement setting out the progress made in the development of the generation of electric energy by atomic means and including a concise summary of the many and varied projects in which the private electric utility industry has a hand and in many cases is carrying out wholly with its own means. In that statement he sets out the position of our industry, and I urge your careful consideration of it.

As to the future, I believe, and I think you will agree, that there are three logical steps in the development of this art of electrical generation by atomic means; namely, (1) a broad and expanding program of fundamental research, (2) the design and construction of what might be called experimental reactors and which may be of pilot proportions, and (3) the construction of intermediate size ex-

perimental prototypes. Such of these as prove successful will no doubt be followed by the construction of large-scale demonstration powerplants which, even though some of them may not have a long period of usefulness, will nevertheless serve to stabilize development and to afford the knowledge that only continuous operation on a practical scale can bring out. I think that the announcement of the 60,000 kilowatt plant to be built by Pacific Gas & Electric Co., using the type of reactor developed at the much smaller Vallecitos experimental and prototype plant, is a good example. It may lead in time to the construction of a larger reactor of say 200,000-kilowatts electric capacity of the same type. Expensive staff and operating procedure, and extraordinary equipment and capital costs will, in my opinion, require that the economical units of the future must be of the order of 500,000- to 1,000,000-kilowatts electrical capacity or larger.

A rapid expansion of the development of the art of generating electric energy from the atom is more likely to occur when a number of groups of manufacturers and of electric system operators have opportunity to strive for enlarged markets, prestige, and a reasonable profit on their part in such a development. That is the way the present art of electric generation was developed. Edison, Thompson, Stanley, Lamme, Tessla, and hundreds of others worked diligently and successfully to lead in development and profit by it. Devices had to be brought out of the laboratory and into the shop and onto the market quickly and ahead of others to insure their success. The best way to develop this new art of generation from atomic energy is to make these same conditions apply and to make the knowledge gained from the Commission's enormous research program and its research laboratories and plants available to the private electric industry, and to loose the members of the industry from the restrictions of some of the provisions of the present Atomic Energy Act which, even if desired at the time of their enactment, are not applicable to the problems which we are considering today.

I would like to leave with you some suggestions for facilitating the development of this art.

I suggest for your earnest consideration the following in addition to the present practices and to the broadening of the Commission's authority to participate in research and other cooperative activities in connection with developmental plants:

1. That since all source material and especially nuclear material by the terms of the Atomic Energy Act of 1954 belongs to the Commission, and since the next generation of reactors and very likely the ones succeeding it are largely developmental and likely of replacement or perhaps entire rebuilding in a few years' time, provisions should be made for periods of at least 10 years in which the Commission might contract for the developer to have use of fuel and the services of the Commission's plant in reprocessing fuel in a way to aid his development toward being justifiable. The privately owned utility business is extremely well regulated by the various governmental authorities and as you gentlemen must realize investments in these first plants will not be profitable for a long, long time.

2. Groups of cooperating companies should, for the purpose of this development, be permitted to form corporations or foundations without necessarily becoming holding companies under the law. Senate

bill 2552 has already been introduced and I believe is adequate to provide the relief which would be necessary and to fully protect the public interest.

3. Corporations or foundations formed for the purpose of building developmental plants should be permitted to finance largely by debt on a fixed amortization schedule and Securities and Exchange Commission should be requested or directed to permit such arrangement. I believe SEC has already been helpful in this respect.

4. The companies should have relief for the purposes of this type of project from the preference clause of the Atomic Energy Act. The application of this clause would only invite bickering and difficulty; there would be little or nothing to be gained by the favored bodies.

If procedure incorporating these suggestions can have the recommendation of your committee and the Commission and be approved by the Congress, you will greatly enlarge the opportunities for privately financed utilities to engage in developmental projects. We believe that as data from the operation of plans now under construction becomes available, and if the suggestions I have made can be adopted, the development of the art will receive renewed impetus and will move forward at an accelerated rate of which this Nation may be proud. In addition, the Government would be free of the necessity of the expenditure of many millions of dollars on building developmental plants, of the administrative costs of the projects, and of the extra costs and difficulties of conducting an operation outside its proper field.

This business of providing the electric supply for our Nation is built on vision, research, skill, and prompt and effective execution. The privately financed electric utility industry of this Nation has made an unequaled record among industries in matching, and to such a large extent offsetting, the ravages of inflation on our customers' pocketbooks. This has been the result of scientific progress, careful appraisal, and prompt and direct action. With your help in relieving us of these outdated restrictions, I believe much progress will be made toward the application of these same methods and talents to a rapid and expanding development of the art of generating electricity supply from the energy of the atom and that it is neither necessary nor is it expedient to have the Government construct large-sized atomic energy electric generating stations.

I greatly appreciate the opportunity to appear before you. I will be glad to try to answer any questions that may occur to you.

Chairman DURHAM. Thank you very much, Mr. Thomas. You have some good suggestions in your statement, and the committee is very glad to have them. You are probably in the most challenging field of the whole atomic-energy industry.

Mr. THOMAS. Thank you, sir.

Chairman DURHAM. At least it is entirely new for atomic power.

At the present time I would like to know how you coordinate your group with the AEC in carrying out your research work. Do you exchange information freely back and forth?

Mr. THOMAS. We have been assured of the exchange of information. Our work has been developmental in its early stages.

Chairman DURHAM. Have you been refused information where you have requested it?

Mr. THOMAS. Not to my knowledge, sir. No request has been refused.

Chairman DURHAM. The reason I ask is that we have quite a program going on in this field under Dr. Smyth, at Princeton.

Mr. THOMAS. I had the assurance before we went into this, we would have access to this information when the time came.

Chairman DURHAM. In other words, you feel that when you reach the point where you need the information, you will get it?

Mr. THOMAS. I do, sir.

Chairman DURHAM. Do you have any questions, Mr. Hosmer?

Representative HOSMER. Yes, Mr. Chairman.

Mr. Thomas, how much of the $10 million has been consumed thus far?

Mr. THOMAS. I believe we have paid in, so far, the first million and a quarter of our share.

Representative HOSMER. What has been accomplished?

Mr. THOMAS. The construction of preliminary experimental apparatus. It is not classified, I am sure. The restricting tube and condenser banks, the bringing about of the auxiliary apparatus and measuring instruments, and experimental procedure to harden in that particular piece of apparatus.

Representative HOSMER. Do you know whether or not this effort is, to any extent, of a restricted nature?

Mr. THOMAS. It is, sir.

Representative HOSMER. To what extent?

Mr. THOMAS. We have to have the Q-clearances to have knowledge of it or to visit.

Representative HOSMER. Is your research foundation restricted in what it receives from General Dynamics in the way of information?

Mr. THOMAS. To the best of my knowledge, sir, only to the extent of things that might be beyond our classified permits, and I know of none.

Representative HOSMER. Has anyone in the foundation had to go through a security procedure?

Mr. THOMAS. I am sure, sir. Everyone wears their badges and has their clearances. It is my understanding that they are thoroughly checked and are, in fact, working on some things for the Commission, itself.

Representative HOSMER. As vice president of the Atomic Energy Research Foundation, are you required to be cleared for security?

Mr. THOMAS. Yes, sir.

Representative HOSMER. Are all of your employees required to be cleared?

Mr. THOMAS. Only those who have access to restricted information. Mr. Hallock here is executive vice president of the foundation. He is so cleared. The custodian of any records or reports we have is so cleared. Nothing is put in the hands or available to anyone not properly cleared.

Representative HOSMER. Do you anticipate that the $10 million amount would be consumed prior to the expiration of the 4 years designated for your program?

Mr. THOMAS. It is quite possible that might come about, sir. We have contemplated that.

Representative HOSMER. Is there any indication now of what attitude the foundation would take regarding the devotion of additional funds to this?

Mr. THOMAS. There has been no decision in that respect. There has been an acceptance from the very beginning that they might go farther. In view of what has occurred to this time, I think it quite likely that they will want to go on, in respect to time and money as well, I might say.

Representatives Hosmer. Does the foundation have any target with respect to the accomplishment of some processes that would be practical for use in utilizing fusion power?

Mr. THOMAS. We are all 21 years old, and we know better than to expect the rainbow too soon. But it is our considered opinion that these 4 years might lead to a controlled reaction in respect of extent and time that would indicate the way to go on to a productive reactor. That is a net energy output reaction.

We have no hope of accomplishing that in this short period of time.

Representative HOSMER. At the present time, however, you cannot say whether or not the foundation would be willing to put up more than the $10 million?

Mr. THOMAS. I would not like to speak for that group, sir, on that subject. They are pretty hardheaded about their money. But I feel that will come about.

Representative HOSMER. I think that is all.

Chairman DURHAM. I suppose most of your funds at the present time have been used for starting from the ground up and building the plant.

Mr. THOMAS. General Atomic is building a $10 million plant.

Chairman DURHAM. You are building that under the advice of the General Atomic?

Mr. THOMAS. The big property is their property. The fusion property is part of it. In the fusion building, and experiment and equipment is where our money is going. Then we have the advantage of the consultation and advice of a great number of scientists who are working in that general field but not always on our experiment.

Chairman DURHAM. I am sure you are aware of the fact that we have spent quite a sum of money already and a large amount of work has been done which is available.

Mr. THOMAS. Yes, sir.

Chairman DURHAM. I am particularly glad to see some private enterprise getting into this field because the possibilities are there to control this.

Mr. THOMAS. We might be very fortunate, the ones to break through. At least we can accelerate. At least we will have our young men and our operating people somewhat familiar with this art ready to take over when the time comes.

Representative HOSMER. I believe I better ask what I had in mind a little more directly and candidly than I did before. What I am getting at, Mr. Thomas, is whether this $10 million is a gesture on the part of the utility companies in Texas to placate public opinion to the fact that you have some interest, or whether it is actually a serious effort.

Mr. THOMAS. I am glad you asked it directly, sir. I think that is best. We are in it because we expect to be up with progress in the art of carrying on our business. We expect with the people we are working with and with our backing to make substantial progress for ourselves, for the industry, for the country as a whole in this art. We are not in the position of making any stopgap or short-term announcement. We are putting our money where our mouth is, and I am quite sure we will continue to do so.

Representative HOSMER. What brought doubt in my mind is when you rather hedged about what the situation might be beyond this specific 4-year $10 million program.

Mr. THOMAS. In my own opinion and feeling about it, I do not desire to hedge. But I do not like to say positively to you that we will spend other peoples' money until they have a chance to vote on it. I think they will. They are tremendously interested. All the directors, save two, have been out to the experiment, witnessed what is going on and are very much pleased with it.

Representative HOSMER. Then you do sincerely feel that unless it turns out to be a complete dud, that the foundation would carry forward its efforts?

Mr. THOMAS. I do, indeed. Even if all of them did not go along, there are a smaller group that would want to go along with it.

Representative HOSMER. Thank you, Mr. Chairman.

Chairman DURHAM. Thank you very much, Mr. Thomas. We appreciate your statement.

Mr. THOMAS. Thank you for the opportunity.

Chairman DURHAM. The next witness this morning is Mr. Frederic de Hoffman, vice president of General Dynamics Corp.

STATEMENT OF FREDERIC de HOFFMAN, VICE PRESIDENT, GENERAL DYNAMICS CORP.

Mr. DE HOFFMAN. Thank you, sir.

Chairman DURHAM. We are glad to have you with us this morning. You may proceed.

Mr. DE HOFFMAN. Thank you, Mr. Chairman.

Mr. Chairman, members of the joint committee, I was very glad to receive your invitation to tell you something about the programs underway at the general atomic division of General Dynamics Corp.

General Atomic's mission is research, development, and production in the nuclear field. It was established with the firm belief that the shortest route to effective nuclear development is dependent upon a thorough understanding of the fundamental scientific and engineering facts. Technology in a field as complex as nuclear energy cannot at this stage in the development of atomic energy be separated from research and development.

The establishment of the John Jay Hopkins Laboratory for Pure and Applied Science as the cornerstone of the work of General Atomic was, therefore, a natural step. We have endeavored in this laboratory to emphasize the role of science in modern technology and to create an atmosphere which can combine the conditions of academic research and freedom of inquiry with the resources and dynamic methods available in large industrial organizations. Our concept, then, is not

merely to develop ideas conceived elsewhere, but to provide an environment which will encourage the birth of new concepts and minimize the time for proving them out.

It is certain that development and prototype production time can be held to a minimum if the men who develop and produce have close association with those men who were responsible for the original research. This need then makes it evident that intensive research in the atomic energy field, not only development and production, must be pursued vigorously within industry itself and that even the best of research within the universities and national laboratories cannot replace this function within industry. Within our own corporation we have recognized this need by providing a $10 million research complex for the John Jay Hopkins Laboratory funded by General Dynamics Corp. which makes it one of the very largest privately financed general purpose nuclear research facilities in the world.

We hope that Congress and the executive branch share with us this recognition for the need to stimulate effective research within industry itself. The role such industrial laboratories can play need not be a narrow one, but can well include activities of broad interest to the entire national nuclear effort. Particularly, we are still in need of a vast amount of basic information. A concerted effort by industry to produce this fundamental information will then, we believe, permit programs directed toward a specific reactor to proceed more logically and rapidly.

Much as I have stressed the way in which industrial research must interplay with the whole national atomic energy effort, I do not wish to imply that industry can afford to ignore its responsibility to assist in supporting and encouraging research carried out in universities. To the contrary, industry must learn to bear an increasing share of such cost and place its support where it will be truly effective.

Allow me now to turn to the subject of programs carried out at General Atomic.

In 1956, we felt the need for the creation of an inherently safe research and isotope producing reactor of sufficient power to be useful to universities, research institutions, and industry. Therefore, entirely new fuel-moderator elements of solid homogeneous uranium-zirconium hydride were developed with resultant unique safety characteristics. The inherent safety of this core promises to open up wide industrial applications of short-lived isotopes, particularly in continuous process control. This program is typical of the new approach which I believe to be necessary. Theorists at General Atomic invented the concept; chemists and metallurgists created the new fuel; engineers played an intimate role from the earliest phase to design an economical product and finally experimental physicists tested out the concept. As a result, in little more than a year, an entirely novel reactor core was conceived, developed, and tested.

Our corporation's belief that economic nuclear power (i. e., that competitive with fossil fuel power) could and would be developed was the prime reason for establishing General Atomic. Our whole modern civilization is dependent on energy utilizations. What greater challenge can there be for a large corporation than to meet this need.

In 1956, we, therefore, set up a group to pursue vigorously the choice of a really promising nuclear power system. While the accumulated experience of the group in the atomic energy program of the Nation was very large, it was not predisposed toward any pet theories or pet projects through either company or Government-sponsored reactor projects.

We believe the following 5 main points are essential in achieving an economic system:

1. The system must be technologically simple.
2. The system must have a high thermal efficiency and lead to low initial capital cost.
3. The system must be capable of producing steam at modern steam conditions (pressures above, say, 1,200 p. s. i. and temperatures above, say, 1,000° F.) so that using the reactor as a heat source does not turn the clock back when coupling it with the turbo-generator.
4. The system must be capable of long burnups without changing the fuel elements, so that a minimum handling of radioactive substances is involved.
5. The system must at least be close to being economical without reprocessing. Consequently, when it becomes a commercial reality, reprocessing will be a definite bonus to the system.

Early in 1957 we concluded that high temperature gas cooling would best meet the above criteria. Since the heat transfer properties of gases at high temperatures are good and since temperature and pressure can be chosen independently for a gas coolant, there is no need to design the reactor to withstand the enormously high pressures characteristic of other systems. Consequently, a high temperature gas-cooled reactor can become a relatively simple, compact, lightweight structure.

Specifically, the use of a high temperature reactor coolant has two very great advantages. To begin with, through the use of an appropriate heat exchanger as a boiler, it leads to modern steam conditions in terms of pressures above 1,200 p. s. i. and temperatures above 1,000° F. Secondly, it effects considerable reduction in capital costs. Small and compact heat exchangers can be used as boilers because of the high density of the steam and because of the large available temperature differences between the high temperature gas and the high pressure steam. Also, a system which can use a coolant at high exit temperatures can operate with a very large rise in temperature of the coolant as it goes through the reactor, thereby decreasing the required cooling flow rate for a given heat output and considerably reducing the pumping power as well as the size of the reactor vessel and piping. The greater thermal efficiencies, of perhaps 35 percent to 38 percent, available through the high temperatures, result in a smaller required thermal output and consequently a smaller reactor system than for low-temperature plants. It is the above considerations, in addition to the decreased operating costs resulting from the higher efficiencies, that are the compelling arguments in favor of high temperature reactors.

Two such high temperature gas-cooled power reactors are now under development at General Atomic; one involves heavy water as the moderator, and the other graphite. For the latter system we now have an experimental program underway. The reactor design

for this system, both in terms of the reactor proper and in marrying it to the turbogenerator system, is also underway.

As you may know, San Diego Gas & Electric Co. last year joined with us to work on this fission power program. In fact, one of their men is working within our central station power group, and active liaison, both on the technical and management levels, is maintained.

We believe that our reactor systems will be set into the proper framework if, at the very outset, utilities participate with us in developing systems with characteristics required for the entire operating powerplant.

Let me now turn to the subject of marine propulsion. As you know, General Dynamics' Electrical Boat Division has unique experience in nuclear marine propulsion. Also, for some time in the past it had been interested in, and has examined the feasibility of closed cycle gas turbine systems. Therefore, it was natural soon after organizing General Atomic to form a group to study nuclear propulsion for merchant ships and to have this group examine the closed cycle gas turbine system. Subsequently, a design feasibility study was carried out by General Atomic for the United States Atomic Energy Commission. This study, as well as those undertaken by other organizations, has indicated great promise for this system as a propulsion plant for merchant vessels. The success of such a project depends, however, upon advancement of gas-cooled reactors and gas turbines beyond existing technology. We have currently been selected to carry out a 5- to 7-year program leading to a land-based prototype for the AEC and the Maritime Administration.

From the very beginning of General Atomic, the problem of controlled thermonuclear reactions has been of deep interest to some of our senior staff. Lying as it does in the nebulous realm between idea and reality, it presents a great challenge to the true scientist. From the point of view of the corporation, too, there were many reasons for entering this exciting field. We felt that we had ideas and could provide the theoretical and experimental scientific support and the research facilities to make a substantial private effort most worthwhile.

The committee is aware that the Texas Atomic Energy Research Foundation joined with the General Dynamics Corp. in supporting a $10 million research program in the field of controlled thermonuclear reactions. That is a program to which each of us contributed $5 million.

The corporation was very pleased at this reaffirmation by a group of leading utilities of the importance of entering this very new and challenging field.

We feel that, apart from the possible ultimate achievement of power from this new source, other important industrial applications will undoubtedly stem from thoughtful research in the thermonuclear field. For example, we feel that important advancements may well stem from the technology which must be developed to handle very large currents of the order of 1 million amperes, with switching time as short as one-millionth of a second, from the design and fabrication of coils to produce intense magnetic fields, from the development of new high temperature materials, and from the opening up of the whole new field of plasma physics—that fourth state of matter

consisting of free electrons and ions. The scientists at General Atomic are striving to understand at each stage the basic physical phenomena that are taking place in plasma handling apparatus. By a close coupling between experimental work and theoretical physics, we hope to achieve a firm foundation at each stage for the development of the next approach to a controlled and a stable heated plasma.

Let me close by reiterating that there is much to learn as yet in many fields fundamental to any successful approach to nuclear power and that industry must play a decisive role in the research and development effort.

Chairman DURHAM. Mr. de Hoffman, you could use that paper at a scientific seminar. It is an excellent explanation of your operations and what you are trying to do.

Will you tell the committee just how you work with this Texas group?

Mr. DE HOFFMAN. Yes, I will be very pleased to. To begin with, the corporation itself started a research program in controlled thermonuclear reactions. As I told you, a considerable number of our staff, including myself, had a personal interest in this field. We started on, I would say, a low-level effort which involved continuing theoretical work that some of our staff had taken a deep interest in, creating new ideas in this field. When we felt that this effort had taken on somewhat concrete shape—for instance, Dr. Marshall Rosenbluth, who is with us, and probably one of the senior theorists in this field in the United States—felt that it was worthwhile to support this in a large-scale experimental way.

We therefore approached the appropriate officials of the Texas utility companies, and particularly Mr. Thomas, who together with his group showed a very farsighted approach to this problem, and felt that it would be worthwhile for us to jointly spend $10 million in the next 4 years to turn these ideas closer into reality and to actually do experimentation on a scale which we alone were, at that point, not ready to support unless we really found some help to go forward in this field.

As it works out in practice, the scientific direction of this effort is under the direction of Dr. Creutz, who is the director of the John Jay Hopkins, of our division, and directly under Dr. Donald Kerst, whom some of you may know as the inventor of the betatron, who has joined our staff permanently.

There is a large theoretical effort on it. We have built a building on our site which will be used exclusively for the machine which we are creating in the thermonuclear field. There are small laboratories attached to it. It is a big effort as a whole; the entire laboratory of General Atomic is available to this effort. We cut across fields. We draw a metallurgist out of our department of metallurgy, a chemist out of the department of chemistry, a theoretical physicist out of the department of theoretical physics, and assign them to this project which accountingwise is shared in terms of cost between the Texas Atomic Energy Foundation and ourselves.

The way we keep the Texas people wrapped in as closely as we can into this effort is to encourage their visiting with us, to tell them on a management level how we are proceeding.

We had the pleasure, for instance, recently of having the entire board of the Texas Atomic Energy Foundation visit the laboratory, take an active interest in looking at the experiments, discussing with us where we were going.

We have liaison with them from both sides in a close way. They have assigned a man by the name of Colonel Hallock, who is in this room today, to work with us closely to see how things are going. We render them every few months—I believe it is every 6 months—a classified report on the status of the program. We render them more infrequent, both classified and unclassified, written and personal reports of where we are going.

I believe this gives you in a nutshell how it goes.

Chairman DURHAM. Doctor, I believe you worked with Dr. Teller in this program for quite a while?

Mr. DE HOFFMAN. Yes, I had the pleasure of doing so.

Chairman DURHAM. That leads me up to this question. Since you are now out of a Government laboratory and in private enterprise, how do you feel about classification in this field at the present time, or how does it affect private enterprise?

Mr. DE HOFFMAN. I will be glad to speak to this, being an old classification man. I don't know whether you remember I used to serve on the AEC Declassification Committee, so I find it amusing to testify on this subject in a different context.

I think even way back at that stage, when we first considered in the laboratories what we would do—I say we now as a member of that committee—we had a considerable split opinion among all the scientists whether we would or would not declassify in this field.

As you know, in this area nothing is really black and white. It depends almost entirely on a question of timing. Many of us took at one time the tack that this clearly should be held classified, and as time wore on, without trying to change our position, but simply being realistic of how life proceeded, said that now the time has come for declassification.

I think you will know yourself that this is precisely what the whole Atomic Energy Commission's effort has been in this field. It has been a gradual moving toward declassification as things became available.

Let me merge this with the field of access, because if there were no access to industry, I would, and so would the AEC, state to you, that it would be necessary to declassify right off the whole field.

Chairman DURHAM. You mean if you made any progress?

Mr. DE HOFFMAN. Yes. I think if you did not have the access permit program, then there would be definitely a need to just clearly state that if we wanted to continue with the whole industrial effort in the country, we would have to go this route. Actually the Commission, and I think wisely, some while back chose the route of giving access to industries.

I think I should perhaps clarify and add to the statements of Mr. Thomas to the extent that we in General Dynamics were one of the first access permittees on the controlled thermonuclear program. We frequently make use of this privilege.

I think what Mr. Thomas meant to say is that the Texas foundation as such has not of the Atomic Energy Commission requested a specific document with access to specific information. We, running the scien-

tific program jointly for General Dynamics and the Texas foundation, having need often, requested information, sent our people to Government laboratories, got access to the information, and in general try to act, I would say, almost as an additional laboratory in the whole national effort in this field.

True we are outside the direct scope of the Government, but I think you will find that in terms of interchange and working with our colleagues in other laboratories, we have a close connection and a continuing back and forth exchange of people and ideas.

Chairman DURHAM. Does that access permit permit you to exchange freely with the Texas group the information that you get under that permit?

Mr. DE HOFFMAN. Yes. You may recall there is a category of information called C–20 which is access to controlled thermonuclear work. We first obtained this access permit when we showed the need by actually contributing to this field. Our friends in the Texas Atomic Energy Foundation equally got the access permit, C–20, extended to them. So we are completely free to discuss with them within that field anything that we ourselves have access to.

Chairman DURHAM. You have had broad experience, and your group is not just in one field. You are in all fields of basic research.

Mr. DE HOFFMAN. That is right.

Chairman DURHAM. How many people have you employed at the laboratory now?

Mr. DE HOFFMAN. At the moment our employment stands slightly in excess of 300, and in terms of projections toward midyear and the end of the year, it will be about 430 or 450. Of those, about 50 people hold doctor of philosophy degrees, to give you some idea of the composition of the group.

Chairman DURHAM. Physicists, chemists?

Mr. DE HOFFMAN. Physicists, chemists, metallurgists, engineers, and all types.

Chairman DURHAM. Having worked in basic research in this field now for some years, and also having worked under the 1954 act, do you see any need for any change in the act at the present time to carry on in this field of basic research?

Mr. DE HOFFMAN. I do not see any problems in the field of basic research. I think I should emphasize that while my statement may have given the impression of emphasizing research, General Atomic as a whole is a broad attempt to encompass the entire field of research development and production.

I would say in the development and production field there are probably many legislative points that could be clarified. As you are well aware, I am not a lawyer and should not speak to these points. But it is clear that if the question of indemnity in terms of working abroad could be further clarified, this would be a very useful thing.

There are items of this kind. I do not think there are major changes needed. I think I welcome the continued efforts of the Atomic Energy Commission and your committee to continuously get together about problems such as these to try to smooth them out.

Chairman DURHAM. I know you are aware of the fact that a thorough study is being made by the Harvard Law School at the present time.

Mr. DE HOFFMAN. Yes, I think that is a useful function.

Chairman DURHAM. Would you mind telling the committee, if it is not against your rules or trade policy, how many contracts you have with the AEC at the present time?

Mr. DE HOFFMAN. No, not at all. The major one is on the maritime gas-cooled reactor. Outside of that, we hold only a very few small contracts in the research field. We hold a contract for perhaps thirty or forty thousand dollars in the field of corrosion studies. We hold another very small contract in the field of high temperature chemistry, that is, investigating fission products. That is just about all in those fields. We do not have a large number of individual research contracts.

I think it might be a good time for me to state quite freely that this is probably due to the time at which our group has come into existence. I think you are all aware that research, as opposed to large-scale development funds, were not in ample supply in the last year and a half, and therefore initiation of new programs was not an easy thing for Government agencies to undertake.

Chairman DURHAM. How does that compare with private enterprise? Do you have many contracts with private enterprise at the present time?

Mr. DE HOFFMAN. The largest one we have is with the Texas group for the 4-year period. We are largely and quite deliberately in a sense of knowing where our money goes, as opposed to being delighted at the large sums that it takes, spending our own funds in this, and without going into too private data, I think it is clear to you that maintaining a force of about 300 research people is a very large expenditure per year, running into the millions of dollars rather than into anything else.

This is, of course, beyond the $10 million capital funds which we have put into this. So we are talking about an exceedingly large investment in this field of more than tens of millions.

Chairman DURHAM. Do you do work for the Army, Navy, Air Force?

Mr. DE HOFFMAN. We have a small amount of research work for the Air Force on items involving atomic beam work, this we started, when it was of interest to us for both basic physics work and fusion work. This field of atomic beam work has turned out to be of considerable interest to the Air Force, and they have asked us to do some work along these lines.

Chairman DURHAM. Being a pioneer in this field, which you are, the thing that has always concerned me very deeply is the fact that the Government owning laboratories, of necessity, in the atomic energy and thermonuclear field, I can see through your process of getting this basic research in its proper perspective some day; that is, private enterprise conducting it and the Government getting out of the business in the years to come.

At the present time we have to carry on because we have the tools. It is an approach that I like personally, myself, of getting basic and fundamental research back in the hands of civilian individuals. I feel we will make more progress in that way than in any other way.

Mr. DE HOFFMAN. Mr. Chairman, we feel it is not only a question of philosophy, with which I heartily agree with you, but even a

question of necessity in the sense that we do not believe that a man who develops any product will develop this product well if he is simply delivered a set of blueprints and asked to make this particular thing. We feel he has to understand it way back when, if you want to cut the cost of developing this particular product in industry.

Chairman DURHAM. And that is practically our operation today in this country. Our basic research and fundamental research has been in the departments of government.

Mr. DE HOFFMAN. It has certainly tended to that.

Chairman DURHAM. We have more and more in the Army and Navy and Air Force desiring to control it further. For example, the control of space. I think that should be in the hands of civilians. Thank you.

Are there any questions, Mr. Hosmer?

Representative HOSMER. Yes, Mr. Chairman.

Dr. de Hoffman, you are director of the General Atomic division?

Mr. DE HOFFMAN. I am division general manager.

Representative HOSMER. Where are your headquarters?

Mr. DE HOFFMAN. Our headquarters are in San Diego. The actual laboratory is just north of San Diego. That is, still within the city limits of San Diego but what is commonly known as La Jolla. There is a 300-acre site which has been voted to us by the citizens of San Diego in an election to start this new research laboratory.

If you are interested in the fact, I will be delighted to show you a photograph of the operation as it now appears.

Representative HOSMER. I have seen pictures of it, thank you. Are there other locations at which the Atomic division carries on its work?

Mr. DE HOFFMAN. No; General Atomic carries on its work principally in San Diego. It has two locations in San Diego, the new 300-acre site and a temporary location in downtown San Diego. However, it utilizes the resources of the entire General Dynamics operation which is a much larger complex.

On the marine gas-cooled reactor, while this work has been started with General Dynamics and involves a nuclear reactor system, it also involves the propulsion system and therefore is carried out as a joint effort between General Atomic and Electric Boat.

In this case, for example, a project leader, Dr. Pickforth, has been drawn from the ranks of the General Atomic's staff, but he will have actually a staff with him combined from Electric Boat and General Atomic personnel. In that sense we do operate over a much broader set of physical locations.

Representative HOSMER. Are they not building some facilities up in Connecticut?

Mr. DE HOFFMAN. The Electric Boat division already has facilities to work on the marrying of reactor systems to the turbopropulsion end of it. To that extent, it has research laboratories, has buildings, machines, and facilities. These will be utilized in this program, as well as, in this particular case engineering specialists in the marine aspects of this particular problem.

Representative HOSMER. That work is partly being done in California and partly in Connecticut?

Mr. DE HOFFMAN. That is correct.

Representative HOSMER. It is being done by two of General Dynamics' divisions?

Mr. DE HOFFMAN. That is correct, sir.

Representative HOSMER. When did you go with General Dynamics, if I may ask?

Mr. DE HOFFMAN. I joined General Dynamics early in 1955, just about 3 years ago.

Representative HOSMER. You had been with the Commission up to that time?

Mr. DE HOFFMAN. I had been with the Commission in some sort of continuing relationship since, I guess, about Christmas of 1943, at Los Alamos.

Representative HOSMER. May I ask if this laboratory organization that you have described was conceived and put into execution by yourself as head of the division?

Mr. DE HOFFMAN. Let me put it this way. I think we are far enough along so that I should say "Yes" to this. I hope that this concept is turning out to be something which we can be proud of, and therefore I am happy to say "Yes" to you. On the other hand, I think the proof of the pudding will come in a few years down the road, whether we really can put on the shelf for some of you the reactor systems which we so proudly speak about. I think we have tried and honestly tried to marry a new philosophy into industry, of combining people with highly academic backgrounds, trying to do the same kind of thing that was done so successfully in the Manhattan District, where those people were married with engineers of a high capability and worked very well together. Our scientists and engineers are interested not in just one narrow line of work, but you see from the short description of the lab that we try to move over a great fraction of the waterfront. Thereby we are hoping that when you go down a narrow path in one field, like the controlled thermonuclear field, you will have the experts in the adjoining field which you have to draw upon right with you.

You will have the ceramicist who helps in high temperatures reactor research and also in the fusion process. In consequence, you will have a better ceramicist because he has a wider scope.

Representative HOSMER. As a matter of fact, this is the same organizational concept, essentially, that you find in the Government laboratories?

Mr. DE HOFFMAN. I think that is almost correct. I think it has one more thing. I hope it combines with it the vigor and push that an industrial organization, can bring which a Government laboratory cannot accomplish simply because of its size and its tentacles being intertwined with other things. I think you are right, say the organizational concept of the Brookhaven Laboratory which combines the divisions, as well as project work, and keeps the men on specific assignment as well as general interesting research, would come very close to forming the basis of how we run projects.

Representative HOSMER. You described the Hopkins Laboratory as a $10 million project. Has the $10 million already been spent?

Mr. DE HOFFMAN. Allow me to say when you asked was it my concept, I spoke very clearly about carrying out a concept and hedged on whether it was my concept or not. I think you should realize that much of the basic vision that went into this was not only the vision of the board of General Dynamics, including Mr. Pace, its present

president, but particularly the vision of the founder, John Jay Hopkins, after whom the laboratory was named.

He envisioned that kind of laboratory in industry and encouraged the board and the rest of the officers of the corporation actually to put it into practice.

As to the amount of money in the ground, I think the situation will actually be that by the end of this year something close to $9 million will be in the ground. There are 220,000 square feet under construction, all of which will be ready in approximately August. It is all being built at once. About 50,000 to 60,000 square feet of one large building is being occupied and working. These are not paper figures of what we intend to spend, but realistic figures of what we will have spent by the end of this year.

Representative HOSMER. Let me say I think it is highly exemplary that industry will pick up whatever concept is a good one for this type of work and has the courage and vision to sink the amount of money in it that you people have done.

Getting back to the financing, I think the Texas Foundation said they had sunk about a million and a half dollars into this fusion. How much of that is included in this $10 million?

Mr. DE HOFFMAN. Not at all. Let me clarify this. These numbers happen to coincide, and they are both very large and maybe we should have differentiated. General Dynamics Corp. took $10 million for capital facilities of the General Atomic division which it would privately provide. This is a large laboratory complex which per se was done before the fusion project was even conceived.

We then set aside separate operational funds running into the millions per year which would run this laboratory. In addition, we then made a contract with the Texas Atomic Energy Foundation where each of us would contribute $5 million over 4 years to run a fusion project.

This fusion project would draw upon the resources of the laboratory, its people, it would use its buildings and so forth, and it would build one particular building, namely, the building in which the machine could be housed for the fusion thing.

Representative HOSMER. Do you charge against that project capital amortization?

Mr. DE HOFFMAN. Yes, we do. Just like any other project of the laboratory would be charged. When Mr. Thomas says that a million and a quarter has been paid in, this means that between us the cost of this project has been $2½ million or $2.4 or whatever it came out over the last year; we split it down the middle and each pay our own share. That is correct.

Representative HOSMER. What I would like to find out is how much of this $10 million laboratory is purely out of the company treasury and how much is out of amortization on account of contracts either with the foundation, with other private customers, or with the Government.

Mr. DE HOFFMAN. I do not think I can answer this in detail. I think it is a fairly private matter which I would be glad to discuss in a more executive session.

Representative HOSMER. That is all right.

Mr. DE HOFFMAN. Let me put it this way. A small amount, because, as you know, things like buildings are written off over a large number of years. Quite clearly there is every intention on General Dynamics Corp.'s part to recover the money that has gone into the buildings as well, eventually, as the money that has gone into building up this laboratory, or it would not be a good sound business venture from the point of view of the stockholder.

There is every intention to spend this money in the expectation that we will create what we consider to be the proper structure and that over the years proper recognition of this structure, in the large sense and not in the sense of the physical structure, will bring it back. For instance, by developing a new reactor which we hope is sufficiently good so that somebody will want to snap it up, we will start building these things and charging the normal profit on these reactors.

This is the kind of business we would like to see, rather than to talk about necessarily getting it back from certain contracts and so forth. Our concept is to be the man who invents the better tooth paste, develops it and sells it.

Representative HOSMER. That is what I was trying to get at. How long is General Dynamics vision in terms of its risk?

Mr. DE HOFFMAN. I hope it is rather large. This is not an attempt to put together a laboratory which will run out and try to recover its costs by some sort of means, but to create better products which then in the normal commercial way, it can sell.

Obviously, since the sums are so very large in this field, any encouragement for us to hew to this program and finally get there is an appreciated matter. I think this is the best way to put it.

Representative HOSMER. I suppose what you said with respect to capital costs would also apply to operational costs?

Mr. DE HOFFMAN. Very much so. We spend several million a year in this laboratory, and one way to look at it is, that is written off, this is getting you into business. Another more realistic view from the stockholder's point would be to say, 10 years down the road is there enough in this field so you can, indeed, make this stockholder's money and get a return on it.

I think we feel the challenge of providing economic nuclear power is so great that we can see few other fields into which to put the corporation to do both justice to the country, the people who work these, and the stockholder. We feel that this is a perfectly merging set of circumstances rather than opposing.

Representative HOSMER. Is your Canadian division intertwined in this in any way, shape, or form?

Mr. DE HOFFMAN. No. Only to the extent that our Canadian division comes down and talks to our people. We go up there and talk some to them. But as you know, it is a subsidiary and run as quite separate corporation in Canada, and does some nuclear work for the Canadian Government. We would interchange information with them, I would say, as we would with any other group that we would welcome to see in the same field. Of course, more closely, if they needed help on some aspects.

Representative HOSMER. The atomic division would do none of their research for other divisions of the company?

Mr. DE HOFFMAN. Yes, if called upon, it would do so. We feel that as an adjunct to creating a very broad approach on the nuclear energy

field, it is simply necessary, as I have described, to have the theoretical physicist who spends part of his time being interested in as abstruse a subject as Meson Theory.

A good example, when we started the atomic beam work, we started it because it was (a) of interest to some research staff members to hold their interest in pure physics problems, and (b) it was of interest in the controlled thermonuclear field.

Before long, with the advent of sputnik, it turned out to the rocket people it was of considerable interest, to actually measure some properties of hydrogen and oxygen atoms with this kind of equipment; and today, for instance, we are training in that division some men of our Convair division in the use of this equipment and will help them with building it and so forth. In that sense, we do carry out research for other divisions.

Representative HOSMER. How much of your workload consists of nonnuclear research for other divisions of the company or for your own division?

Mr. DE HOFFMAN. Essentially nil. It is a very small porportion. The largest proportion is directed into the nuclear-energy field, and there the largest proportion is directed toward nuclear power.

Representative HOSMER. This isotope-producing reactor you have described, I imagine, is one of those packages that you hope to sell on a commercial market and make some money out of it?

Mr. DE HOFFMAN. That is correct.

Representative HOSMER. The fuel elements that you have described, solid uranium, zirconium hydrid elements, was not conceived, designed, engineered, and manufactured from the very beginning in your laboratory?

Mr. DE HOFFMAN. Yes, it was, sir. I am glad you asked about this. If you allow me a minute, I would like to comment on that.

We actually got a group together in 1956 that looked over the research reactor situation. Incidentally, way back, I had something to do with creating a research reactor in the Government. In fact I helped another man, now with us, Don Kerst, on the first water boiler. We felt there was a need for a new kind of research reactor. We actually asked our theoretical group to think the situation through and it came to the solution that if there were a new fuel element made which would combine the moderator and the fuel element in solid and homogeneous form, that we would be in very good shape to carry out a new physical concept.

Representative HOSMER. Was that a pure, virgin concept with the atomic division?

Mr. DE HOFFMAN. As far as I know, it was. I do not want to say that this may not have arisen at other places around the world, as almost all physical concepts do. It was a new concept thought through at our place. We wanted, to be quite technical, we wanted to see whether if the reaction shut itself off, it would do so promptly. We wanted to assure ourselves that it would not do so by melting the fuel elements even if they ran at reasonably high power.

We, therefore, came to the conclusion that if we mixed the uranium with the moderator, we would enable the neutrons to not get moderated down to as low a temperature as they normally would in case the fuel element got hot. This, in turn, would shut the reaction off.

Representative HOSMER. In the work, did you not draw on a vast storehouse of knowledge with respect to the chemistry and metallurgy and the physics of these materials that were used, you were dealing with?

Mr. DE HOFFMAN. Yes. We drew back as far as 1893, when somebody managed to make a little zirconium hydride out of interest rather than out of any future nuclear application.

Representative HOSMER. What I was getting at is that you did not have to go all the way back in basic research for this?

Mr. DE HOFFMAN. Yes, we went pretty far back. Let me say this, Mr. Hosmer. I should make it clear that as a basic commercial venture merely to build this research reactor, this would have been a rather crazy proposition unless we sell an enormous number of them. The main reason for doing this was to try to test out a new concept, and prove this relatively small group could take it all the way through.

At that time we did not know whether zirconium hydride could be made in large bars without cracking, with uranium and zirconium together, to the best of our knowledge it had never been hydrided. We, therefore, started with the basic metallurgy of this, developed it, went through the production processes of trying to set up production lines to make uranium-zirconium hydride, and actually turned out fuel elements.

Representative HOSMER. Was this all done at General Atomic?

Mr. DE HOFFMAN. Yes.

Representative HOSMER. At San Diego?

Mr. DE HOFFMAN. Yes.

Representative HOSMER. The fabrication?

Mr. DE HOFFMAN. Yes. In fact, the first experiment on zirconium hydride we had a rented schoolhouse which San Diego kindly turned over to us. The first experiments in zirconium hydride were carried out in a little room 4 by 8 feet which had been one of the teachers' restrooms. This gives you a feeling of how basically we started in a small way to get this going.

Representative HOSMER. I think one of the other programs started out in a restroom, too.

Mr. DE HOFFMAN. At the same time the theoretical physicists were examining this concept constantly. By the time the uranium-zirconium hydride was made, the critical assembly was ready, and actually when we got the prompt negative temperature coefficient, which we hoped for, a bottle of champagne was taken out of overhead and broken out. We were quite happy with this.

Chairman DURHAM. This is like the experience where the first chain reaction was produced.

Representative HOSMER. Where did you get the craftsmen to work on this matter?

Mr. DE HOFFMAN. I think this is a kind of chain reaction. Among the senior scientific staff what happened was this. I asked Professor Crentz, who was then chairman of the physics department at Carnegie Tech, to join us. I had known him at Los Alamos during the war and he had always felt that a new way among scientists to approach technological problems could make very large progress for the country. I knew of his desire for this.

I asked him if he would head the laboratory. He agreed to do so. His background was very broad not only in physics but in metallurgy and other subjects. I think this is probably one of the strongest points of how we try to work. I have tried to take no man in a senior position in the laboratory who does not at least in some ways encompass two fields.

Representative HOSMER. What I am getting at, Did he do this work with his own hands or did he hire a craftsman?

Mr. DE HOFFMAN. He did some work with his own hands. He hired other craftsmen. Particularly I was trying to describe the snowballing process of getting other men who were attracted by his feeling that this was a good idea and who gradually joined us. Men like Professor Pigford, who is now the chairman of our engineering department, whose own background is engineering and chemistry.

It would be natural that the younger men who worked with Pigford and Creutz would want to come to such a place.

If you are referring further down to technicians and so forth, again we tried to draw them in many instances out of places that these senior men had been. One of the attempts I made at the early stages of setting this up was to say that we were not going to decrease the number of people by merely reshuffling them out of different places, but increase the sum total competence for the country.

There were many who had gone back and gone into other industries, other laboratories, universities, out of the atomic energy industry, because they did not have the proper framework in which to work. It was a consistent attempt on our part to collect men like that back.

Representative HOSMER. That is what I am getting at. At certain universities where there is an outstanding man or outstanding facility, it operates like a magnet to attract good minds and skilled people.

Mr. DE HOFFMAN. That is right.

Representative HOSMER. You feel that is what you are developing at the Hopkins Laboratory?

Mr. DE HOFFMAN. That is what we are hoping. I can give you an example. Because we built in a slow enough and deliberate enough way, I hope, we have never run an advertisement for personnel up to last month. We have used precisely the approach that you describe. We hope in the future to see a further merging of this with university approaches.

I think I mentioned to you that I feel the responsibility of industry in this respect. Now that you have asked me, I think I should tell you that we, as General Dynamics Corp., made a $1 million grant to the University of California to enlarge its San Diego facilities with the hope that it will become a great technological center of university training in the sciences and particularly in the technological sciences.

Representative HOSMER. What you have described was part of the original concept of setting up this laboratory. It is not something that has just developed?

Mr. DE HOFFMAN. That is right.

Representative HOSMER. You deliberately designed it that way?

Mr. DE HOFFMAN. That is correct.

Representative HOSMER. In your specifications for the economic reactors, you said they had to be safe and cheap and easily built, as I think Admiral Rickover one time said, all reactor concepts are, until

you start to build them. You have taken the gas-cooled reactor approach. How far into that are you?

Mr. DE HOFFMAN. I would say that in one particular concept, given a few more months of deciding whether we want to do it and how we want to do this, that following 18 months further, we would be ready to actually build the prototype. I think that is the best answer I can give. We would hope, hopefully, to have it running—I am sticking my neck way out and will probably get it chopped—I would say 5 years.

You can say, and you will be right, that any reactor concept is always 5 years off. But I think this is a fairly realistic statement.

Representative HOSMER. Graphite, moderated.

Mr. DE HOFFMAN. That is right.

Let me turn to Tom Pigford, without getting into very detailed company information—who can give an order of magnitude number for a 60-megawatt prototype or 400-megawatt reactor for the outside physical dimensions of the pressure vessel?

Mr. PIGFORD. For 60-megawatt heat this becomes a vessel of approximately 7 feet in diameter. It has the same power density as the present pressurized water systems in core.

Representative HOSMER. Is this a closed-cycle system?

Mr. DE HOFFMAN. No.

Mr. PIGFORD. It is a closed cycle, not a gas-turbine cycle.

Representative HOSMER. If you achieve this prototype, would you say that you will have done so at about the same cost as would be achieved in a Government laboratory, or cheaper or more expensive?

Mr. DE HOFFMAN. You are in some ways asking how good we are. I guess, being head of the outfit, I will have to say we are awfully good or otherwise I would not believe in us. With this qualification, let me try to say that I believe we can accomplish it quicker than it could be accomplished in a Government laboratory if we turn to and do this in the proper manner just because I believe we can combine the fundamental research with the development with immediately going into some of the production problems and do it all under one set of circumstances.

In principle, this ought to decrease the time. In practice, of course, we could be equally unlucky and it could lengthen it.

I think in principle it ought to decrease the time in which you can do this. I will not say that you could do this without large facilities which the United States has already built. It would be foolish of me to say, for instance, that if we took this job on and had no access to the largest test reactors existing that we could carry out this program. I am saying within the framework of our industrial-Government cooperation that has developed I hope we could do it equally fast or faster.

Representative HOSMER. You conceive of this job as purely a company venture, or will you seek some cooperation from the reactor demonstration program?

Mr. DE HOFFMAN. I think it is too early to say this. I think our attempt in the next few weeks and months is to get this concept to a stage where we really know what it takes to produce, what it takes in experimentation, and then to try and talk to some of the people that are interested in this concept and try to see how we want to carry it.

I think this would depend on items such as what is the size of the demonstration unit that we should approach.

What is the method of carrying it forward?

I think we are too early a stage to decide this.

Representative HOSMER. Have you settled down on what gas you will use yet?

Mr. DE HOFFMAN. I think probably for the first prototype——

Representative HOSMER. You do not have to answer that.

Mr. DE HOFFMAN. I am happy to answer it.

At the first prototype we will be operating with helium. I can see the time down the road when the supply of that gas is in short supply and one has to think of the other gases. By this time we hope a concept such as this will be developed far enough so that other gases can also be used.

Representative HOSMER. How much of the information in this particular concept is usable in the maritime gadget?

Mr. DE HOFFMAN. They are quite separate.

Representative HOSMER. This is just from the reactor standpoint.

Mr. DE HOFFMAN. That is right. From the reactor standpoint, the maritime reactor has an almost agreed-upon ground rule between all of us and not something that is imposed, to be something, which is using more or less present day fuel elements or an extension of these. This can get us a reactor which is very usable and which uses very high pressure gas which is going to be used directly in the closed cycle system.

The graphite system, under consideration with us, relies on entirely new fuel elements which have been to a large extent—and I say to a large extent because ideas arise all over the world—conceived at our place, which we hope will run at exceedingly low gas pressures and therefore make simple and cheap pressure vessels possible, and therefore is really an entirely different concept except for the fact that both recognize that high temperatures in gas cooling are a useful route.

Representative HOSMER. Would you be able to say what reactor temperatures you are going to operate at?

Mr. DE HOFFMAN. The temperatures that I have actually cited to you before are precisely the ones we hope to achieve. We would be having reactor outlet temperatures of about 1300° F., in order to achieve those steam temperatures.

Representative HOSMER. How much have you drawn on British technology?

Mr. DE HOFFMAN. I would say we have drawn very little on British technology in the following sense: I think if it came to using certain gas pumps I would feel very free to consult certain British firms to find out how their gas pumping technology had actually gone forward. I would say that at the moment we have not drawn on any at all.

I would also say that this system is quite different from the Calder Hall system which is a low-temperature system and therefore there was no attempt here to draw on that technology.

Representative HOSMER. They are making some efforts in the high temperature direction.

Mr. DE HOFFMAN. They are making some efforts in the high temperature direction and, to the best of my knowledge, all their high-

temperature work at the moment is either classified or unavailable to the technical public, so we have not drawn on any of that.

Representative HOSMER. Would you anticipate that this gas-cooled plant that you are building would in fact be "shockingly" cheaper in capital costs than the pressurized water or boiling water reactors?

Mr. DE HOFFMAN. You have put up two goals to shoot at. I think the answer is a definite "Yes."

Representative HOSMER. It would amount to a breakthrough if this works; is that right?

Mr. DE HOFFMAN. I think that is a correct answer, sir.

Let me ask you, Dr. Pigford, to qualify this from your point of view.

Dr. PIGFORD. I think it is a strong advancement. I think the word "breakthrough" should be reserved until we have made some experiments, until it looks as good as we think it will.

Representative HOSMER. You are aiming for a breakthrough?

Mr. DE HOFFMAN. Yes.

Representative HOSMER. There is just one othre line of questions I have, and that is with respect to the controlled thermonuclear work you are doing.

I am wondering, with the extent of the programs at Los Alamos and at Princeton, if you are not rather duplicating and wasting scientific talent that can be used elsewhere?

In answering that, would you touch on the exchange of information or lack of it that you have with these people?

Mr. DE HOFFMAN. Yes, sir. First of all, this is one of the first considerations I looked into before even establishing the program because I feel very strongly as you do that one must not splinter groups below critical sizes.

On the other hand, the controlled thermonuclear effort is such a vast field of understanding, items like plasmas, which simply have never existed on earth before, that I believe it needs a considerable number of approaches, and again I think I should say outright that we pride ourselves, I hope correctly, that we can have created an atmosphere where research of precisely this type can flourish very fast.

The work going on is therefore by no means a duplication. I cannot, because of classification questions, today go into the details. But, for instance, let me give you a feeling.

One of our senior theorists, Dr. Rosenbluth, has worried a lot about the formation of whether the pinch is stable or not stable, which, as you know, is one of the crucial questions in one form of approach.

This has been reexamined in our place. We found certain of his own formulations to be incomplete. By being together with some of the people that are available and drawn upon at our place he has reformulated and we are going forward with a slightly different—I would say quite different—experimental program than any of the places have underway.

I would not want to say that you could not at Los Alamos have that program going, too, but I think you will find that almost any group freezes into given lines of work. This is just a natural force that happens.

I think if we went today to any of the existing laboratories and showed our program to them and say, "Why aren't you doing it,"

they would say, "We wish you luck, we hope you get there first, but we think we will get there first with our set of approaches."

I think any group has a finite number of roads that it will go down on. I think this field is large enough so that it needed more really good groups to go down new roads. I think in a general way this is my feeling.

As to the exchange of information, let me add one more thing. I think it is probably likely that at our place there may be more attention paid to the ceramic problem involved in this field than there might be at certain other places. The reason is that we have those people in this field. Ed Crentz' basic interest dates from way back in that field. He has a group at our place that is interested in this and he will go forward.

If you took Ed Crentz, in one of the existing projects which is not very strongly in that field of ceramics for other reasons, it is not likely that they would build up a big ceramics group because this one man joins.

So I think each have their own destiny, quite apart from the other, as in any big scientific search.

The next step on interchange of information, I would say that if we were today cut off, which we certainly are not, from the access to what is going on in this field in the Government laboratories, we would be in an exceedingly silly position and I doubt that any of our people would feel that they would want to work in this field.

We welcome having this access very, very much. It has to be a program that goes forward together. To go forward with some portions of this program under secrecy is a different question.

Our people are not denied access to any information in Government laboratories. It is a question of whether we tell this to third parties. The question is, really, are we shutting ourselves off from a large number of foreign scientific people for whom this is a very challenging field who would like to help us and who, under the present rules, we cannot embody in this? This is a policy question which is far broader than our own lab. This is a question of what the United States wants to take as a position in this field.

I do not want to deny that further moves in this direction cannot per se be beneficial to solution of the problem, but they may not. This is a gamble which you have to evaluate.

Representative HOSMER. In short, you have satisfied yourself in your own mind that it is a profitable nonduplicating line of inquiry for the private laboratory?

Mr. DE HOFFMAN. That is right. The only proof of the pudding I have in this respect is that when our people talk of our friends in the Government labs these friends do visit us to find out where we are going and what we are doing. So I have some positive proof that this is not merely a duplication, I know it is not scientifically, and beyond that I know it is a real effort.

Chairman DURHAM. There is one point I am a little bit concerned about. At the present time, in the access-permitting program, you have to have the necessary need to know. The university laboratories in the country are more or less excluded from this program under the present system of operation.

Mr. DE HOFFMAN. To the following extent: They are excluded from the direct participation. They are not excluded from learning quite a lot of the facts, which are in fact declassified.

Again, I would say you are certainly right that any moves that the Atomic Energy Commission is undertaking in the direction of further declassification are generally beneficial in this area and merely have to be weighed against the overall picture.

Chairman DURHAM. I think we all have to admit that the preponderance of basic research is in the universities of this country. I think you will agree with me on that.

Mr. DE HOFFMAN. I think I will agree with you on that.

Let me say, however, how you can integrate such people. We have, for instance, in our controlled thermonuclear program, a summer session each year. In this summer session one of our strongest attempts is to draw men like Prof. Freeman Dyson of the Institute for Advanced Study, who is about as pure a theorist as any of my friends can get to be. Yet, Freeman got very interested last year in the controlled thermonuclear program looking from the outside in without knowing anything about it.

He said that he was sufficiently interested to undergo the process of being cleared for this particular project and joining us and has actually worked with us on this field.

So while it is true you do not have free interchange in the universities in this field, I think it is true that a considerable number of the topnotch university physicists are actually working on the Sherwood project in one form or another or in private projects like the Texas-General Atomic project.

For instance, this summer we have a man like Professor Chandrasekar, who is one of the top astrophysicists, joining our project in several months. We have made a strong attempt not to lose this large reservoir of manpower. The main reservoir of manpower we lose by classification is that beyond our own shores and the reservoir of manpower who are not United States citizens in our own country.

Representative HOSMER. I have one last question, Doctor.

In this thermonuclear research you have given examples of byproducts, such as the development of new high-temperature materials. That in and of itself would probably be beneficial to some of the other divisions of the dynamics complex.

Mr. DE HOFFMAN. Yes. Or to the country as a whole. In other words, our decision to spend that large a sum of money in that far-reaching project was based on two considerations:

First, the real intrinsic worth of that project, and saying that learning new things in this field will be beneficial.

Second, that having research going on in this field will in our place keep minds actively at work that will also have lots of ideas on shorter-range products, like reactors.

Third, that if you learn, as you say, high-temperature materials can be useful in jet engines, they can be useful in any other old thing, that as large and diversified corporations as we are in have interest in even if it does not create those particular projects.

Representative HOSMER. Even in the gas-cooled, too?

Mr. DE HOFFMAN. I do not think you would get anything from the thermonuclear research that would help you in that. I think you would be in quite a different range of temperatures there.

Representative HOSMER. Thank you, Dr. de Hoffman. I have certainly enjoyed your testimony a great deal.

Chairman DURHAM. Doctor, what do you think of the application of this to propulsion systems such as the airplanes and the rockets? Have you tried to look into that in any degree?

Mr. DE HOFFMAN. I definitely think that nuclear energy per se has considerable promise along that line, and it must, simply because it is one of the most efficient ways of converting energy into useful forms. I do not think we have in all instances found the way of doing this properly. But I am quite sure that there are very large fields here that are profitable.

Were you talking about the controlled thermonuclear in particular or generally the atomic energy?

Chairman DURHAM. Thermonuclear.

Mr. DE HOFFMAN. Then I should reverse myself. I believe the major uses for controlled thermonuclear energy, and again it is very bad to crystal ball and say things cannot be done, but I will attempt to do just that, are in very large systems.

Let me now describe why I feel this. You know of the enormous magnitudes of the magnetic fields we are talking about to control this. We are talking about having fields of a million amperes flowing down wires and things of this kind. This will take very large equipment to do. To then further extract energy out of this is not likely to be a simple process and probably will take further large equipment, and therefore I will say that the critical mass of equipment will become so large that only when you take a very large amount of energy out of this system are you likely to justify the amount of equipment you have put up in the first place. Almost all mobile applications use small amounts of energy and therefore I cannot foresee this very easily. It is dangerous to predict what cannot happen but this looks to me like the situation at the moment.

Chairman DURHAM. Thank you very much, Doctor. You have given us a very interesting statement.

Mr. DE HOFFMAN. Thank you, sir.

Chairman DURHAM. The next witness is Mr. Elmer L. Lindseth, Edison Electric Institute.

We are very glad to have you with us, Mr. Lindseth, and you may proceed.

STATEMENT OF ELMER L. LINDSETH,[1] PRESIDENT, CLEVELAND ELECTRIC ILLUMINATING CO., AND CHAIRMAN, EDISON ELECTRIC INSTITUTE COMMITTEE ON ATOMIC POWER

Mr. LINDSETH. Thank you.

My name is Elmer L. Lindseth. I am president of the Cleveland Electric Illuminating Co., and chairman of the Edison Electric Institute Committee on Atomic Power. The Institute represents 189 member companies which serve 96 percent of all customers of the investor-owned segment of the utility industry. These customers comprise 75 percent of our Nation's electric users. It is in behalf of these investor-owned companies and their customers that I am testifying here today. This statement has been authorized by the Institute's

[1] See appendix, pp. 602–608, for address by Mr. Lindseth on February 4, 1958, entitled "1958: Year of Decision in Atomic Power."

Committee on Atomic Power. The makeup of this committee is attached.

INVESTOR-OWNED UTILITY PROGRAM

In the 3½ years since passage of the Atomic Energy Act of 1954, the Nation's electric utility companies have embarked on a substantial number of nuclear projects, which together comprise a broad industry program aimed at bringing about economic nuclear power.

Today this program includes 14 announced nuclear power projects involving a total utility investment of a half a billion dollars. This sum does not include AEC expenditures in furtherance of certain of these projects. Three are in operation; 6 are either under construction or under contract, and 5 are in various stages of planning. The nine projects that are either in operation, under construction or under contract will involve utility company expenditures of over $320 million. The five projects in various phases of planning are expected to involve further utility company investments on the order of $200 million.

In addition, the program includes 12 other nuclear research, development, and study projects calling for continuing expenditures of substantial sums of money. It is expected that some of these will lead into additional reactor construction projects. In all, 123 electric utilities are participating in the program. These are listed in appendix I.

PROGRESS DURING PAST YEAR ON UTILITY PROGRAM

During the last year there has been continuing and accelerating progress and expansion of the electric utility companies' program. Since our appearance before this committee a year ago, the following principal developments have taken place:

(1) Major construction work on the 180,000-kilowatt Dresden nuclear powerplant at Joliet, Ill., began in June of 1957.

(2) Major construction work on the 100,000-kilowatt Enrico Fermi plant near Monroe, Mich., proceeded according to plan.

(3) Site work on the Yankee Atomic Electric Co., 134,000-kilowatt plant at Rowe, Mass., was started.

(4) Site work on the Indian Point 275,000-kilowatt plant of the Consolidated Edison Co., of New York, Inc., was essentially completed.

(5) A contract was signed between the Northern States Power Co., Central Utilities Atomic Power Associates and the AEC for the construction of a 66,000-kilowatt plant at Sioux Falls, S. Dak., under the third round of the power demonstration reactor program.

(6) Pacific Gas and Electric Co., announced on February 19, 1958, that it had completed negotiations with Bechtel Corp., for the construction of a 50,000-kilowatt advanced boiling water nuclear plant at Eureka, Calif. Completion is scheduled for mid-1962.

Further details concerning the projects mentioned in items 1 to 6 are given in appendix II, including information concerning financial assistance.

(7) Three nuclear powerplants in which electric utility companies are participating were completed and began operation in 1957. These include the Vallecitos, Santa Susana, and Shippingport nuclear powerplants for which utility companies provided the electric gen-

erating facilities. In the case of Shippingport the utility company contributed toward the cost of the reactor and is operating it for the AEC. Details concerning these projects are given in appendix III.

(8) Three definitive proposals were made to the AEC under the third round of the power demonstration reactor program for the further development and construction of nuclear powerplants. These include proposed projects of the Carolinas-Virginia Nuclear Power Associates, East Central Nuclear Group-Florida West Coast Nuclear Group, and the Pennsylvania Power and Light Co.-Westinghouse Electric Corp. projects. In the case of the last project the AEC announced on February 26 that it had accepted the proposal as a basis for contract negotiations. Further details of each of these are given in appendix IV.

(9) Four new research and development groups in which electric utilities are participating were formed during the year and added to the program. These include the Southwest Atomic Energy Associates, which recently signed a 4-year $5.3 million contract for research and development of an advanced reactor type; the Texas Atomic Energy Research Foundation, which has signed a contract for a 4-year $10 million jointly financed thermonuclear research project with General Atomic Division of General Dynamics; American Nuclear Power Associates; and San Diego Gas & Electric Co. Details on these projects are shown in appendix V.

(10) A number of other companies participating in various research and study projects announced prior to 1957 continued their investigations of various aspects of nuclear power development. These are listed in appendix I.

Indicative of the continuing expansion of the electric utility companies' program in this field, expenditures in furtherance of nuclear power development have been increasing substantially as previously announced projects advance and new projects are undertaken. By the end of 1957, cumulative expenditures by electric utility companies totaled over $80 million. During 1958 they are expected to increase by 50 percent over 1957 to reach a cumulative total of 140 million by the end of the year. Next year they are expected to increase even more than 50 percent over the 1958 level to reach a cumulative total of over 230 million by the end of 1959 or nearly half the $500 million electric utility companies are planning to spend for presently announced nuclear power projects. A summary is shown in appendix VI.

THE FUTURE

Our industry looks to the future of nuclear power with confidence. We recognize, however, that both the technical and economic hurdles to be overcome are formidable and that considerable time, effort, and funds must be devoted to the problem before success will be attained.

The technical feasibility of generating electric power with nuclear fuels has been clearly established. But economic feasibility is another matter. The achievement of this is now the primary objective of our industry's nuclear power development program. This objective will only be reached with new techniques and knowledge over and above those available today.

We believe the soundest course toward early achievement of competitive nuclear power lies basically in research and development.

Our industry is of the opinion that it is still too early to restrict its program to a few promising types of reactors. Rather, the required advances will come about primarily through continuation of our present research and development program associated with a wide range of reactor types. Such research and development should include fundamental investigations in physics, metallurgy, and chemistry on which the whole technology is based; research of a general nature that would benefit many reactor types, such as fuel element technology, and directed research and development of specific reactor types, including construction of reactor experiments.

On this broad foundation, pilot and prototype plants (with or without generating facilities) should be constructed together with large-scale reactors where construction of these is warranted by the status of technology developed through the research program. All three of these stages are now in progress in the program now underway in the United States.

There has been criticism of the overall adequacy of our Nation's program of nuclear power development. We believe, however, that the rate of progress in this country in the development of nuclear power in terms of our domestic needs has been both substantial and adequate. Continuation of our efforts will, of course, produce an expanding store of knowledge and experience and this progress will, in turn, produce further gains.

The suggestion has been made that both our national objectives and the steps required to reach our objectives in atomic power should be defined more specifically. Our industry would find helpful such definition of the Nation's objectives for the development of nuclear power, both domestic and international, as well as specific steps indicated to achieve such objectives.

We as an industry will make available to the fullest extent possible our resources of experience, organization, and financial support to help meet these objectives. We also believe it to be important that any steps indicated to achieve the objectives as defined should be carried out within the framework of our free enterprise system. We have always viewed with great concern proposals to build Government-owned nuclear powerplants. The electric power generating capacity in America today is already more than 23 percent Government owned. Further expansion of Government ownership of power generating facilities is cause for alarm. We are today engaged in a bitter cold war with Russia over the philosophy of totalitarian versus democratic government. We must not defeat the very objectives we are trying to achieve in that cold war by abandoning our principles of free enterprise along the way.

We would like to point out, too, that continued expansion of the current program will require continuance and probably an increase in Government financial assistance and participation. Details of such financial participation by the Government are not suggested, but it is apparent that optimum progress will require broad administrative authority be granted by the Congress to permit flexibility. As reactor technology continues to broaden, the types of incentives available should be flexible enough to foster research and development of all promising reactor types. With such flexibility, and by making use of our free enterprise system, it will be possible to achieve

optimum progress toward the given objectives with a minimum amount of Government expenditures.

We believe that any United States program should be in accord with the principles as stated in the Atomic Energy Act of 1954, that—

> the development, use, and control of atomic energy shall be directed so as to * * * strengthen free competition in private enterprise.

In our previous testimony before this committee, we voiced our objections to sections 44 and 182 (c) of the Atomic Energy Act as being completely contrary to such principles, unfair to taxpayers generally and particularly to customers of the investor-owned power industry. The unfair and unjust preference clause relating to the disposal of electric energy states in part—

> * * * in contracting for the disposal of such energy the Commission shall give preference and priority to public bodies and cooperatives * * *

The institute and its member companies also urge deletion of the preference clause relating to license applications, as contained in section 182 (c) of the act, which states in part—

> * * * Where such conflicting applications resulting from limited opportunity for such license (for the generation of electric power) include those submitted by public or cooperative bodies such applications shall be given preferred consideration.

Eighty percent of our citizens in America receive electric service from the investor-owned segment of the utility industry. It is unfair, in principle and in practice, that this vast majority of citizens should be discriminated against in either the disposal of power generated or in the granting of licenses in favor of a 20 percent minority who already in their electric bills bear less than that share of taxes and interests costs borne by the vast majority of our citizens.

In conclusion, our industry feels that the current program underway for the development of economic nuclear power is substantial and adequate to meet domestic needs and we advocate continuation of that program. As an industry, we want to make available to the fullest extent possible our industry's resources in experience, organization, and financial support to achieve the Nation's objectives in the development of nuclear power.

We recognize that continued expansion of the present program will require continuance and even expansion of financial assistance from Government, which assistance should be authorized.

We do not recommend or suggest specific details of plans for such financial assistance; however, we recognize that broad administrative authority will be required to permit flexibility in administration.

Finally, we believe that any program of nuclear power development in the United States should be carried out within the framework of our free enterprise system, not only from consideration of ideology but also from the standpoint of achieving optimum progress toward given objectives with expenditure of a minimum amount of public funds.

To the objectives of realizing ultimately competitive nuclear power we pledge our wholehearted support.

We appreciate this opportunity to appear before your committee.

I would also like to have filed with the record the six appendixes attached to this statement which are a material part of it.

Chairman DURHAM. Without objection, they will be included in the record.

(The appendixes referred to follow:)

ELECTRIC UTILITY COMPANY PARTICIPATION IN NUCLEAR POWER DEVELOPMENT

APPENDIX I

NAMES OF ELECTRIC UTILITY COMPANIES PARTICIPATING IN NUCLEAR POWER STUDY, RESEARCH, DEVELOPMENT AND CONSTRUCTION PROJECTS, MARCH 1, 1958

PROJECTS UNDER CONSTRUCTION OR CONTRACT

1. Consolidated Edison Co. of New York, Inc.
2. Commonwealth Edison Co.
   Nuclear Power Group, Inc.:
   - American Gas & Electric Service Corp.
   - Commonwealth Edison Co.
   - Central Illinois Light Co.
   - Illinois Power Co.
   - Kansas City Power & Light Co.
   - Pacific Gas & Electric Co.
   - Union Electric Co.
3. The Detroit Edison Co.
   Power Reactor Development Co.:
   - Alabama Power Co.
   - Central Hudson Gas & Electric Corp.
   - Cincinnati Gas & Electric Co.
   - Columbus & Southern Ohio Electric Co.
   - Consumers Power Co.
   - Delaware Power & Light Co.
   - The Detroit Edison Co.
   - Georgia Power Co.
   - Gulf Power Co.
   - Iowa-Illinois Gas & Electric Co.
   - Long Island Lighting Co.
   - Mississippi Power Co.
   - Philadelphia Electric Co.
   - Potomac Electric Power Co.
   - Rochester Gas & Electric Corp.
   - The Southern Co.
   - The Toledo Edison Co.
   - Wisconsin Electric Power Co.
4. Yankee Atomic Electric Co.
   - Boston Edison Co.
   - Cambridge Electric Light Co.
   - Central Maine Power Co.
   - Central Vermont Public Service Corp.
   - Connecticut Light & Power Co.
   - Hartford Electric Light Co.
   - Montaup Electric Co.
   - New Bedford Gas & Edison Light Co.
   - New England Power Co.
   - Public Service Company of New Hampshire
   - Western Massachusetts Electric Co.

PROJECTS UNDER CONSTRUCTION OR CONTRACT—continued

5. Northern States Power Co.
   Central Utilities Atomic Power Associates:
   - Central Electric & Gas Co.
   - Interstate Power Co.
   - Iowa Power & Light Co.
   - Iowa Southern Utilities Co.
   - Madison Gas & Electric Co.
   - Mississippi Valley Public Service Co.
   - Northern States Power Co.
   - Northwestern Public Service Co.
   - Otter Tail Power Co.
   - St. Joseph Light and Power Co.
   - Wisconsin Public Service Corp.
6. Pacific Gas & Electric Co. (Eureka)

PROJECTS IN OPERATION

7. Duquesne Light Co.
8. Pacific Gas & Electric Co. (Vallecitos)
9. Southern California Edison Co.

PROJECTS IN PLANNING STAGES

10. Carolinas-Virginia Nuclear Power Associates
    - Carolina Power & Light Co.
    - Duke Power Co.
    - South Carolina Electric & Gas Co.
    - Virginia Electric & Power Co.
11. East Central Nuclear Group
    - Appalachian Electric Power Co.
    - Cleveland Electric Illuminating Co.
    - Columbus & Southern Ohio Electric Co.
    - Dayton Power & Light Co.
    - Indiana-Michigan Power Co.
    - Indianapolis Power & Light Co.
    - Louisville Gas & Electric Co.
    - Monongahela Power Co.
    - Ohio Power Co.
    - Ohio Edison Co.
    - Pennsylvania Power Co.
    - Potomac Edison Co.
    - Southern Indiana Gas & Electric Co.
    - West Penn Power Co.

NAMES OF ELECTRIC UTILITY COMPANIES PARTICIPATING IN NUCLEAR POWER STUDY, RESEARCH, DEVELOPMENT AND CONSTRUCTION PROJECTS, MARCH 1, 1958—Con.

STUDY, RESEARCH AND DEVELOPMENT GROUPS—continued

11. East Central Nuclear Group—Con.
Florida West Coast Nuclear Group
Florida Power Corp.
Tampa Electric Co.
12. New England Electric System
13. Pacific Gas & Electric Co.
14. Pennsylvania Advanced Reactor Project
Baltimore Gas & Electric Co.
Pennsylvania Power & Light Co.
15. American Nuclear Power Associates
Rockland Light & Power Co.
16. Atomic Power Development Associates
Alabama Power Co.
Atlantic City Electric Co.
Baltimore Gas & Electric Co.
Central Hudson Gas & Electric Corp.
Cincinnati Gas Electric Co.
Cleveland Electric Illuminating Co.
Connecticut Light & Power Co.
Consolidated Edison Co. of New York, Inc.
Consumers Powers Co.
Delaware Power & Light Co.
Detroit Edison Co., The
General Public Utilities Corp.
Georgia Power Co.
Gulf Power Co.
Hartford Electric Light Co., The
Indianapolis Power & Light Co.
Jersey Central Power & Light Co.
Long Island Lighting Co.
Metropolitan Edison Co.
Mississippi Power Co.
New Jersey Power & Light Co.
New York State Electric & Gas Co.
Niagara Mohawk Power Corp.
Pennsylvania Electric Co.
Philadelphia Electric Co.
Potomac Electric Power Co.
Public Service Electric & Gas Co.
Rochester Gas & Electric Corp.
Toledo Edison Co., The
Wisconsin Electric Power Co.
Wisconsin Power & Light Co.
17. Atomic Power Engineering Group:
Central Illinois Public Service Corp.
Central Louisiana Electric Co.
Central Power & Light Co.

STUDY, RESEARCH AND DEVELOPMENT GROUPS—continued

17. Atomic Power Engineering—Con.
Interstate Power Co.
Iowa-Illinois Gas & Electric Co.
Kentucky Utilities Co.
Lake Superior District Power Co.
Northern Indiana Public Service Co.
Public Service Company of Indiana, Inc.
Public Service Company of Oklahoma
Southwestern Gas & Electric Co.
West Texas Utilities Co.
18. East Central Nuclear Group. (See item 10.)
19. Minnesota Nuclear Operations Group:
Minnesota Power & Light Co.
20. Nuclear Power Group. (See item 2.)
21. Pacific Northwest Power Company Group:
Montana Power Co.
Pacific Power & Light Co.
Portland General Electric Co.
Washington Water Power Co.
22. Puget Sound Utilities Council:
Puget Sound Power & Light Co.
23. Rocky Mountain Nuclear Power Group:
Arizona Public Service Co.
Idaho Power Co.
Pacific Power & Light Co.
Public Service Company of Colorado
Utah Power & Light Co.
Washington Water Power Co.
24. San Diego Gas & Electric Co.
25. Southwest Atomic Energy Associates:
Arkansas Power & Light Co.
Arkansas-Missouri Power Co.
Central Louisiana Electric Co.
Empire District Electric Co.
Gulf States Utilities Co.
Kansas Gas & Electric Co.
Kansas Power & Light Co.
Louisiana Power & Light Co.
Mississippi Power & Light Co.
Missouri Public Service Co.
New Orleans Public Service, Inc.
Oklahoma Gas & Electric Co.
Public Service Company of Oklahoma
Southwestern Gas & Electric Co.
Western Light & Telephone Co.

NAMES OF ELECTRIC UTILITY COMPANIES PARTICIPATING IN NUCLEAR POWER STUDY, RESEARCH, DEVELOPMENT AND CONSTRUCTION PROJECTS, MARCH 1, 1958—Con.

26. Texas Atomic Energy Research Foundation:	26. Texas Atomic Energy Research Foundation—Continued
Central Power & Light Co.	Southwestern Gas & Electric Co.
Community Public Service Co.	Southwestern Public Service Co.
Dallas Power & Light Co.	Texas Electric Service Co.
El Paso Electric Co.	Texas Power & Light Co.
Gulf States Utilities Co.	West Texas Utilities Co.
Houston Lighting & Power Co.	

APPENDIX II

Plants under construction or contract

Name of organization [1] and plant	Type of reactor	Capacity of plant kilowatt electric	Location	Estimated cost to utility organization	In operation by—
(1) Commonwealth Edison Co. Nuclear Power Group, Inc. (Dresden).	Boiling water	180,000	Joliet, Ill	$51,000,000	1960
(2) PRDC-Detroit Edison Co. (Enrico Fermi).	Fast breeder	100,000	Monroe, Mich	[2] 65,000,000	1960
(3) Consolidated Edison Company of New York, Inc. (Indian Point).	Pressurized water thorium-uranium converter.	275,000	Indian Point, N. Y.	90,000,000	1960
(4) Yankee Atomic Electric Co. (Yankee).	Pressurized water-stainless steel clad fuel elements.	134,000	Rowe, Mass	57,000,000	1960
(5) Northern States Power Co. Central Utilities Atomic Power Associates (Pathfinder).	Controlled recirculation boiling water.	66,000	Sioux Falls, S. Dak.	[3] 28,800,000	1962
(6) Pacific Gas & Electric Co. (Eureka).	Advanced boiling water.	[4] 50,000	Eureka, Calif	20,000,000	1962

[1] Utility company members of respective groups are shown in appendix I.
[2] Over this figure.
[3] Estimated total cost of project including $6,000,000 research and development contribution by AEC.
[4] Guaranteed; 60,000 kilowatt expected.

(1) The Dresden nuclear power station is a project of Commonwealth Edison Co. with the cooperation of Nuclear Power Group, Inc. Major construction on the 180,000 kilowatts (electric) dual cycle boiling water reactor, located 50 miles from Chicago, Ill., was started in June 1957. This plant, privately financed, is being built by General Electric Co. for a contract price of $45 million. In addition, overhead and site costs will be something over $6 million. The contract calls for completion by December 7, 1960. Construction is proceeding ahead of schedule and the project is expected to be ready for operation by the middle of 1960.

(2) The Enrico Fermi plant is sponsored by the Power Reactor Development Co. and the Detroit Edison Co. Atomic Power Development Associates, Inc., is performing research and development and furnishing the reactor design for the project. Major construction began in August of 1956 and is proceeding on schedule toward completion in late 1960. Cost of this plant to the utility organization concerned is expected to be over $65 million. The AEC is contributing the equivalent of $4.45 million toward this project, being constructed as part of the AEC power demonstration reactor program, in the form of research and development work.

(3) The Indian Point nuclear powerplant is being financed and constructed by Consolidated Edison Company of New York, Inc. Site preparation and excavation for this plant is essentially completed and major construction work is scheduled to begin early this year. The plant is expected to be completed by 1960.

(4) The Yankee Atomic Electric Co. is building a 134,000 kilowatts (electric) pressurized water reactor at Rowe, Mass., using stainless steel clad uranium oxide fuel elements. During the past year, Yankee made commitments for the vapor container sphere, the nuclear reactor vessel and components, and for most of the conventional generating equipment. Site preparation work is underway and major field construction is scheduled to start in the spring. The plant is expected to be in operation in 1960. The project, being undertaken as part of the power demonstration reactor program, is expected to cost about $50 million. Total requirements to be financed are calculated at $57 million, including cost of the initial core. In addition the AEC is contributing the equivalent of $5 million in the form of research and development work toward the cost of this project.

(5) The Pathfinder project is a joint undertaking of the Northern States Power Co. and Central Utilities Atomic Power Associates. In November of 1957 it was announced that a contract had been signed with the AEC for the research, development, and construction of this project under the third round of the power demonstration reactor program. Northern States Power Co. is currently considering a site on the Big Sioux River in South Dakota for this plant which is scheduled to be in operation in 1962. The plant, which will be owned and operated by Northern States Power Co., is expected to cost a total of approximately $28.8 million including research and development work. The AEC will contribute the equivalent of $6 million toward the cost of this project in the form of research and development work.

(6) The Pacific Gas & Electric Co. is undertaking the development and construction of a 60,000 kilowatts advanced boiling water reactor at Eureka, Calif. This project, scheduled for completion in 1962, is to be financed entirely with investor funds, including research and development. On February 19, 1958, the company announced it had completed negotiations on a regular commercial basis with Bechtel Corp. for the design and construction of the plant. General Electric Co. will supply the nuclear and electrical equipment. The total cost of the project is estimated to be $20 million.

APPENDIX III

Plants in operation, Mar. 1, 1958

Name of participating utility company and plant	Type of reactor	Electrical capacity of plant, kilowatt-energy	Owner of reactor	Operator of reactor	Estimated cost to utility organization	In operation
(1) Duquesne Light Co. (Shippingport)	Pressurized water	[1] 60,000	AEC	Duquesne Light Co.	[2] $23,300,000	December 1957.
(2) Pacific Gas & Electric Co. (Vallecitos)	Boiling water, prototype for Commonwealth Edison plant.	5,000	General Electric Co.	General Electric Co.	[3] 572,000	October 1957.
(3) Southern California Edison Co. (Santa Susana)	Sodium graphite	6,500	AEC	Atomics International	[4] 1,500,000	July 1957.

[1] Initial capacity ultimate of 100,000 kilowatts expected.
[2] Includes 18,300,000 for the conventional portion of the plant and the site, and $5,000,000 toward cost of reactor.
[3] For turbo-generator portion.

(1) The Shippingport atomic power station, which is jointly owned by the Atomic Energy Commission and the Duquesne Light Co., of Pittsburgh, Pa., was constructed as a part of the AEC reactor development program. Westinghouse Electric Corp. designed and built the nuclear part of the station under contract with the AEC. Planning on this project was initiated in mid-1953, at which time, under the Atomic Energy Act of 1946, industry was not permitted to own and operate its own nuclear power reactors. When Duquesne Light Co. joined in this project, in March 1954, as a result of having submitted the most favorable proposal in response to the AEC's request for competitive bids, this was the only way an electric utility company could participate in the development and construction of a nuclear powerplant.

Construction of Shippingport, a pressurized water reactor station, which benefited by experience gained through construction and operation of the propulsion reactor for the world's first nuclear-powered submarine, was initiated in September 1954, and completed the latter part of 1957. Last December 23 a full 60,000 kilowatts of electric energy—the station's expected initial capacity—was generated and fed into the Duquesne Light Co. system.

The Duquesne Light Co. provided the site, the conventional part of the station, and contributed $5 million toward the cost of the nuclear part. The company is operating the entire plant, including the reactor, and is purchasing the steam from the AEC at a price substantially higher than the cost of steam produced at the company's conventional plants. When the AEC selected Duquesne Light's bid, it estimated that Duquesne's participation in the Shippingport project would reduce the Government's share of the cost by about $30 million. Through 1957, Duquesne had spent $22.8 million for construction of this station.

(2) The Vallecitos nuclear reactor plant in California, a joint project of the General Electric Co. and the Pacific Gas & Electric Co., was started in 1956. It was completed and began feeding electricity into the Pacific Gas & Electric Co. lines the latter part of 1957. This pilot plant for the large scale Dresden nuclear powerplant now under construction is the first entirely investor-financed nuclear power reactor project to be completed in the world. The Pacific Gas & Electric Co. furnished the turbogenerator facilities and the General Electric Co. the reactor.

(3) The sodium reactor experiment, located in the Santa Susana Mountains of California, is a part of the AEC's reactor development program. It was designed, constructed, and is being operated for the AEC by Atomics International. The Southern California Edison Co. installed and is operating the steam electric plant at a cost to date of $1,500,000, and is purchasing the heat energy developed by the reactor for 45 cents per million British thermal units.

The plant was initially placed in operation in July 1957, to become the first investor-owned utility plant to generate and distribute electrical energy from a nuclear reactor. Of major importance in this project is the company's endeavor to develop a liquid metal to water steam generator, vital to the successful generation of electrical energy from all types of sodium-cooled reactors. The company's policy of sharing the information secured on this project with the entire electrical industry includes partially staffing the plant with representatives from other investor and publicly owned utilities.

APPENDIX IV

DEFINITIVE PROPOSALS MADE IN 1957 FOR NUCLEAR POWERPLANT DEVELOPMENT AND CONSTRUCTION

(Utility company members of respective groups shown in appendix I)

1. CAROLINA-VIRGINIA NUCLEAR POWER ASSOCIATES

The Carolina-Virginia Nuclear Power Associates, Inc., formed in 1956, made a proposal to the AEC in September of 1957 under the third round of the power demonstration reactor program for the development and construction of a heavy water moderated and cooled pressure tube reactor nuclear powerplant. The proposed plant, with a capacity of 19,000 kilowatts (electric) would be scheduled for completion in mid-1962. A site at Parr Shoals, S. C., has been selected for its location. At present this proposal is under consideration by the AEC.

2. EAST CENTRAL NUCLEAR GROUP-FLORIDA WEST COAST NUCLEAR GROUP

In December of 1957 a proposal was made to the AEC by East Central Nuclear Group-Florida West Coast Nuclear Group for the development and construction of an advanced heavy water moderated gas cooled pressure tube reactor nuclear powerplant under the third round of the power demonstration reactor program Construction of the proposed 50,000 kilowatts (electric) reactor, to be located in the Florida west coast area, would be scheduled for completion between mid-1962 and mid-1963. This project is an outgrowth of a previous proposal made to the AEC in April 1957 by the Florida Nuclear Power Group for the development and construction of a similar type reactor, but not so advanced a design. This earlier proposal was not found acceptable by the AEC. The present proposal is now under consideration by the AEC.

3. PENNSYLVANIA ADVANCED REACTOR PROJECT

The Pennsylvania Power & Light Co. and the Westinghouse Electric Corp. undertook a comprehensive research and development program on a single-region equeous homogeneous slurry reactor in July of 1955. Baltimore Gas & Electric Co. has recently joined these two organizations in the further research and development program planned for 1958–59. On December 11, 1957, a proposal was submitted to AEC under the third round of the power demonstration reactor program requesting research and development assistance as well as waiver of fuel use charges. Under this proposal, there will be continued research and development during 1958–59 to determine the feasibility of constructing a nuclear powerplant of 70,000 to 150,000 kilowatts. If the feasibility determination is favorable, further research will be conducted in parallel with plant construction. The scheduled plant completion date is December 1963. On Febraury 26, 1958, AEC announced this proposal had been accepted as a basis for negotiating a definitive contract.

APPENDIX V

RESEARCH AND DEVELOPMENT GROUPS FORMED IN 1957

(Utility company members of respective groups shown in appendix I)

1. AMERICAN NUCLEAR POWER ASSOCIATES

In November 1957, the American Nuclear Power Associates was formed. Comprised of 1 electric utility company and 4 industrial and engineering organizations, this group is planning to develop a high temperature helium-cooled, uranium bismuth fueled reactor on which Raytheon, one of the member companies, had done a previous study for the AEC.

2. SAN DIEGO GAS AND ELECTRIC CO.

In July 1957, the San Diego Gas & Electric Co. completed arrangements to participate in the intensive research program on nuclear fission power reactor systems which is being conducted in San Diego by General Atomic Division of General Dynamics Corp.

The company's participation in the program will include taking part in the designing of specific reactor systems. The company hopes that the basic information derived from this and other phases of the research program will prove of value in developing nuclear power facilities that will produce electrical energy at unit costs lower than those now being obtained from powerplants using conventional fuels.

3. SOUTHWEST ATOMIC ENERGY ASSOCIATES

In June 1957, a group of 15 electric companies in the States of Kansas, Missouri, Oklahoma, Arkansas, Louisiana, and Mississippi, announced formation of Southwest Atomic Energy Associates to carry out a research and development program aimed at the overall objective of producing nuclear power that will be competitive with power produced by conventional fuel.

During 1957 the associates carried on negotiations with atomics international, a division of North American Aviation, Inc., and agreed on a program for research and development of an advanced epithermal reactor which would use the thorium U–233 cycle. On January 15, 1958 Southwest Atomic Energy As-

sociates announced it had signed a contract with Atomics International covering a 4-year research and development program, which will cost $5,354,000. At the end of the program, and based upon the recommendations of the contractor, a decision will be reached as to whether a pilot plant or a full-scale plant should be built.

4. TEXAS ATOMIC ENERGY RESEARCH FOUNDATION

In April of 1957 a group of 11 Texas utility companies announced formation of the Texas Atomic Energy Research Foundation. The following month this group signed a contract with General Atomic Division of General Dynamics Corp. for a 4-year, $10 million, jointly sponsored research program in the field of controlled thermonuclear reactions.

APPENDIX VI

Estimate of expenditures by electric utility companies for nuclear power development [1]

	1955 and earlier	1956	1957	1958	1959
Expenditures for plants [2]	$11, 190, 000	$25, 080, 000	$34, 900, 000	$52, 660, 000	$92, 590, 000
Other expenditures [3]	2, 760, 000	1, 990, 000	4, 310, 000	6, 360, 000	No estimate
Total by years	13, 950, 000	27, 070, 000	39, 210, 000	59, 020, 000	(4)
Cumulative	13, 950, 000	41, 020, 000	80, 230, 000	139, 250, 000	[4] 231, 840, 000

[1] Based on replies to inquiries to member companies of the Edison Electric Institute. Practically all electric utility companies known to be participating in one or more phases of nuclear power development supplied information.

[2] Estimate of expenditures by electric utility organizations for following plants in operation, under construction or under contract, including accompanying research and development work, but exclusive of operating expenditures: Dresden, Enrico Fermi, Indian Point, Pathfinder, Santa Susana, Shippingport, Vallecitos, Yankee. Figures for 1958 and 1959 do not include an estimate of expenditures for the Pacific Gas & Electric Co., Eureka project.

[3] Includes expenditures by certain individual companies and the following groups of companies for nuclear power study, research, and development. These figures do not include expenditures associated with any of the eight projects listed in (2) above.

Atomic Power Development Associates, Inc.
Atomic Power Engineering Group
Carolinas-Virginia Nuclear Power Association
East Central Nuclear Group
Florida West Coast Nuclear Group
Nuclear Power Group
Pennsylvania Advanced Reactor Project
Pioneer Service & Engineering Group
Rocky Mountain Nuclear Power Group
Southwest Atomic Energy Association
Texas Atomic Energy Research Foundation

[4] Does not include estimate of "other expenditures" for 1959.

MEMBERS OF EDISON ELECTRIC INSTITUTE COMMITTEE ON ATOMIC POWER

Mr. Walker L. Cisler, president, the Detroit Edison Co.
Mr. W. J. Clapp, president, Florida Power Corp.
Mr. Norman A. Cocke, president, Duke Power Co.
Mr. Charles B. Delafield, vice president, Consolidated Edison Company of New York, Inc.
Mr. Edgar H. Dixon, president, Middle South Utilities, Inc.
Mr. Philip A. Fleger, chairman of the board, Duquesne Light Co.
Mr. George M. Gadsby, chairman of the board, Utah Power & Light Co.
Mr. A. S. King, president, Northern States Power Co.
Mr. Elmer L. Lindseth, president, Cleveland Electric Illuminating Co.
Mr. J. W. McAfee, president, Union Electric Co.
Mr. C. B. McManus, chairman of the board, The Southern Co., Inc.
Mr. I. L. Moore, president, New England Electric System
Mr. Charles E. Oakes, chairman of the board, Pennsylvania Power and Light Co.
Mr. R. G. Rincliffe, president, Philadelphia Electric Co.
Mr. Philip Sporn, president, American Gas and Electric Co.
Mr. J. B. Thomas, president, Texas Electric Service Co.

Chairman DURHAM. Thank you very much, Mr. Lindseth. That is a very fine report.

You have given us a different picture from what it was a year ago. We are all encouraged by the progress being made by private enterprise in this field from the domestic standpoint.

You did not mention anything about the foreign power program. Do you care to say anything about that, or do you have any ideas concerning it and how to meet it?

As you know, we have initiated this atoms for peace program, primarily for this cold war, and we are at the point where we must do something about it if we expect to have the effect that we thought it would have.

Being in this type of business, I thought probably you might have some ideas how we might meet it.

Mr. LINDSETH. Our committee has taken no specific action as regards meeting the international requirements but we are fully mindful of the fact that the international requirements do have an impact on the domestic program.

As regards policy and what you have called the cold war that we have, that is an area in which the Congress has a very specific responsibility and amount of information which naturally transcends ours. Your committee has a great deal of information on that.

Chairman DURHAM. I realize that. I thought from your background of experience and operation in the domestic program such as you have, which is such a large one, that you people might have some ideas as to how we approach this.

I might say this: The industry is competitive over there at the present time and not competitive in this country.

Any man in your position of running a big company, you have to look to your stockholders to handle a large basic research program.

Mr. LINDSETH. In furtherance of these objectives, we recognize, of course, that the development of the program our industry is undertaking is going to be helpful in the world scheme of things. Manufacturers with whom our industry is working closely appear in the export picture, either licensing or actually physically transporting reactors. From them a good viewpoint can be and has been obtained by the committee.

So our place in the picture, we envision, is a continuance of a vigorous program, as I have outlined, expanding it, continuing it, to strive toward economic, competitive nuclear power on the domestic front.

In the course of that development and ultimate achieving of competitive power, as you have pointed out, we may pass certain milestones along the road where a development becomes competitive abroad when it is not yet competitive in the United States, and that technology and know-how would be exportable.

As I said in the statement, we look forward to the future of our program with confidence—confidence that we will achieve the objectives we are all seeking, ultimately competitive nuclear power which will be helpful in the world scheme when we are able to meet the cost conditions at one point or another in the world.

As your committee has pointed out before, this power will be competitive in some areas of the United States before it is in others, depending on the availability and cost of fuel.

We look on our program, continuing and expanding as it is, as being quite helpful in the world scheme.

Chairman DURHAM. You also suggested that the Government is going to have to spend more money in this program. Do you feel that should be spent directly through our system for research and development and make it available to private enterprise, or should we approach it in some other manner?

Mr. LINDSETH. While we said in the statement that we did not prescribe details, as an industry we are firmly of the belief that maximum return from expenditures will probably come about through continued research and development of components, and so forth.

Chairman DURHAM. Over a long period of time?

Mr. LINDSETH. Yes, and over the short period. We are encouraged by some of the important advances which have been made in the past year and which are underway at the moment. So when you say, do we have in mind specific means by which financial assistance could be granted, the first one which comes to mind and the one which we think is most important is in this area of research and development, either preoperational in the design and development stages of a reactor, or after it has gone into operation, with continued research and development toward improving it in the second and third generation of fuel elements and corps.

Chairman DURHAM. If we had a very promising reactor concept, as was outlined here this morning, and private enterprise would not take it on, do you feel that the Government should proceed to build it at least to the point where it can be determined whether or not it is practicable?

Mr. LINDSETH. If it is a reactor experiment, for example, without electric-generating facilities, it is entirely proper that it be constructed at a Government laboratory. Many very important advances have been made through reactor experiments.

The controversial point is when we get into the generation of electric power, which is an established business in the country, and therein have been the difficulties in the past in a meeting of the minds as regards policy.

We feel very firmly that the generation of electric power and the development of reactor types, when they are ready for the generation of electric power, should be on the utility systems of the country.

Chairman DURHAM. Of course, it is very difficult to prove how efficient it is unless you do generate power.

Mr. LINDSETH. We can do a pretty good engineering job when we have a reactor experiment, the output of which would be heat, because the conversion of heat into electric power is a pretty well-established technology in the United States. So when we do have heat from a reactor in the form of hot gases, hot water, hot metal of the type of liquid sodium, while there are some engineering problems, these are decidedly secondary in importance to the basic problems of converting the heat of fission in the reactor into heat in the working fluid. A great many advances have been and can be made without the necessity of generating electric power.

Chairman DURHAM. Mr. Hosmer?

Representative HOSMER. Yes, Mr. Chairman.

I just want to ask if what you have replied to Mr. Durham's questions are considered by you to be an adequate and full reply to this argument: (*a*) International considerations demand that we develop nuclear power at a parity with conventional power; (*b*) you must

have large-scale plants in order to do this, to prove out the technology and economics; (*c*) private enterprise will not construct them soon enough, so, therefore, the Government must.

Have you fully answered that proposition from what you have said or do you want to add anything to it?

Mr. LINDSETH. With regard to the necessity of large-scale demonstration plants, Dr. de Hoffman spoke of the necessity in thermonuclear processes of very large plants, and while he did not mention a figure he meant plants larger than any nuclear powerplants we are today contemplating.

We are building some large-scale nuclear powerplants in the United States. The Dresden plant is 180,000 kilowatts. At the Consolidated Edison Indian Point plant the reactor output is of the order of that. The Massachusetts Yankee plant is 134,000 kilowatts, the Fermi plant is 100,000.

These are large-scale plants. But among the very encouraging and exciting projects in this country are plants half that size.

The one to which Mr. Sporn, Dr. Zinn, and Mr. Clapp will testify this afternoon is 50,000 kilowatts, which, if it becomes successful, will make very marked advances in the technology of high-temperature, gas-cooled, heavy-water-moderated, ultimately natural uranium reactors.

The recently announced boiling reactor for California Pacific Gas & Electric at Eureka is nominally 50,000 kilowatts.

So I submit that we do have the prospect of making very marked advances in the technology of nuclear power without the necessity of very large-scale reactors in the sense of several hundred thousand kilowatts.

Scaling up from the reactor experiments of quite small size—let us say, 5,000, 6,000, 10,000 kilowatts—to intermediate sizes of 50,000 kilowatts gives us a vast amount of information.

As you are quite familiar, the development of the P. G. & E., General Electric reactor (Vallecitos) where the nominal output is 5,000 kilowatts, has given an outstanding amount of information, enabling us to move to successive designs.

Representative HOSMER. In other words, you feel that this proposition is already being met as the industry exists today and for future generations of plants it will be met adequately?

Mr. LINDSETH. As the program continues to expand and we continue to add similar steps to the program underway in the country.

Representative HOSMER. Thank you.

Chairman DURHAM. Thank you very much, Mr. Lindseth. We appreciate your coming down and giving us some of your ideas and thoughts.

The hearing this afternoon will be at 2 o'clock in this same room.

(Subsequently Chairman Durham received a letter dated March 11, 1958, from Mr. Alex Radin, general manager of the American Public Power Association, as follows:)

AMERICAN PUBLIC POWER ASSOCIATION,
Washington, D. C., March 11, 1958.

Hon. CARL T. DURHAM,
Chairman of Joint Committee on Atomic Energy,
House Office Building, Washington, D. C.

DEAR MR. DURHAM: I have just reviewed the recent testimony by Mr. Elmer Lindseth before the Joint Committee on Atomic Energy and feel compelled to

comment to the committee on one aspect of it. In our testimony, presented during the same hearings by James L. Grahl (prior to Mr. Linseth's appearance), we endeavored to stay clear of controversy with the privately owned utility industry in the hope that the important issues in atomic power development could be considered on their own merits. However, Mr. Lindseth included statements in regard to general Federal power policies which are false and misleading. I would be derelict to allow these statements to go into the public record unchallenged.

The passage in Mr. Lindseth's testimony, which he presented in behalf of the Edison Electric Institute and to which I have reference, reads as follows:

"Eighty percent of our citizens in America receive electric service from the investor-owned segment of the utility industry. It is unfair, in principle and in practice, that this vast majority of citizens should be discriminated against in either the disposal of power generated or in the granting of licenses in favor of a 20 percent minority who already in their electric bills bear less than that share of taxes and interest costs borne by the vast majority of our citizens."

In the interests of brevity, I will comment on only two aspects of this statement. First, Mr. Lindseth's statement that 80 percent of American citizens are "discriminated against" in the disposal of power produced by Federal agencies is simply not true. In fiscal year 1956, total Federal power production amounted to 94 billion kilowatt-hours and was sold to the following classes of purchasers in the proportions indicated below:

	Percent
Federal defense agencies	34.8
Private industry	20.8
Privately owned utilities	10.7
Municipal utilities	17.0
State and other public agencies	9.9
Rural electric cooperatives	6.7
Total	100.0

Thus, private industry and the private utilities received almost one-third of the federally produced power, at the same rate schedule as other purchasers. (However, because of their better load factor, privately owned utilities in the Pacific Northwest have been purchasing power at a lower cost per kilowatt-hour than the publicly owned utilities.) With respect to all Federal power, local publicly owned and cooperative systems purchased almost exactly one-third of the total; and Federal defense agencies received more than one-third. This pattern holds substantially true today. It seems entirely fair to conclude from these data that the benefits of federally generated power are rather generally shared and that it would be hard to define a class of citizens who are being "discriminated against." Beyond this, of course, the "preference clause" represents an antimonopoly policy repeatedly endorsed by the Congress.

Second, Mr. Lindseth refers to tax differentials. There is much to be said in refutation of his remarks but I will only point out that the tax status of the privately owned utilities is not quite what Mr. Lindseth implies. For your information, I am enclosing a copy of a news item in the March 13, 1958, issue of Public Utilities Fortnightly (p. 399) which lists 18 privately owned electric utility companies whose dividends in 1957 are estimated to be "wholly or partially nontaxable" because of the operation of liberalized depreciation provisions in the law. The article states that "partially tax-free dividends may be expected to continue indefinitely, with the tax-free proportion of the total payment gradually increasing."

In addiion, I am enclosing a copy of an article on The Truth About TVA and Taxes.

Because I feel quite strongly that Mr. Lindseth's statement should not be permitted to mislead anyone, I would greatly appreciate this letter being made a part of the record of the hearings at which Mr. Lindseth testified.

I should like to thank you for the opportunity for this association to present its views during the statutory hearings and to express our appreciation for the fairminded way in which you have conducted them.

Sincerely,

ALEX RADIN.

[Excerpts from Public Utilities Fortnightly, March 13, 1958, p. 399]

INCREASING NUMBER OF PARTIALLY TAX-FREE UTILITY DIVIDENDS

It is generally known among investors and analysts that some of the former utility holding companies, now changed to investment companies, pay dividends which are entirely free of current income taxes—Electric Bond and Share United Corporation, Central Public Utility, Standard Shares, and possibly 1 or 2 others. Perhaps it is less well-known that some 15 electric utility holding and operating companies in 1956 paid dividends which were partially free of income tax.

Complete data are not yet available for 1957, but apparently several additional electric utilities paid dividends which were partly tax-free. This may perhaps be attributed to the increasing amounts of deferred tax savings resulting from accelerated depreciation, and as these savings continue to increase some new borderline companies may enter the list. On the other hand, some companies like Washington Water Power, whose dividends enjoyed tax-free status because of accelerated amortization rather than liberalized depreciation, are now beginning to lose this benefit.

In general, for those utiilties not affected by the expiring amortization on important plants, partially tax-free dividends may be expected to continue indefinitely, with the tax-free proportion of the total payment gradually increasing. Of course, the chance that Congress may cancel the provision of the 1954 Tax Code which provides for accelerated depreciation should be kept in mind. It is also understood that the Treasury Department is now scrutinizing tax returns more carefully with respect to claims for tax-free dividends, as estimated by companies.

Following is a list of utility companies (and investment companies) whose 1957 dividends are estimated by Sinclair, Murray & Co., to be partially or wholly nontaxable, or to constitute capital gains:

Brockton-Taunton Gas
California-Oregon Power
Central Hudson Gas & Electric
Central Louisiana Electric
Centrail Maine Power
Connecticut Light & Power
Connecticut Power
Detroit Edison
El Paso Natural Gas
Electric Bond & Share
Equitable Gas
Greenwich Gas
Hartford Electric Light
New England Electric
New England Telephone & Telegraph
Oklahoma Gas & Electric
Pacific Northwest Pipeline
Pacific Power and Light
Portland Gas and Coke
Providence Gas
Public Service of Indiana
Public Service of New Hampshire
Rockland Light & Power
Scranton-Springbrook Water Service
Southwestern Electric Service
Southwestern Public Service
Tennessee Gas Transmission
Transcontinental Gas Pipe Line
United Corporation
Virginia Electric & Power
Washington Water Power

(The article entitled "The Truth About TVA and Taxes" is on file with the Joint Committee.)

(Whereupon, at 12:20 p. m., a recess was taken until 2 p. m., this same day.)

AFTERNOON SESSION

The hearing was resumed at 2 p. m., pursuant to the recess.

Chairman DURHAM. The committee will come to order.

This is a continuation of the hearings on the growth and development of atomic energy.

I think our first witness this afternoon is Mr. Philip Sporn, president of the American Gas & Electric Co. and the American Gas & Electric Service Corp., Mr. William J. Clapp, president of the Florida Power Corp., and Mr. Walter H. Zinn, president of the General Nuclear Engineering Corp., I believe you three are together.

Mr. SPORN. Yes, sir.

Chairman DURHAM. You may proceed.

STATEMENT OF PHILIP SPORN, PRESIDENT, AMERICAN GAS & ELECTRIC CO. AND AMERICAN GAS & ELECTRIC SERVICE CORP.

Mr. SPORN. My name is Philip Sporn. I am president of American Gas & Electric Co. and of American Gas & Electric Service Corp. I am also chairman of the Working Committee of the East Central Nuclear Group (ECNG), a group of electric utilities operating in the Ohio Valley and contiguous areas. These companies have joined together in a program of research and development which they hope will result in significant advances in the technology of producing commercially competitive nuclear power. ECNG is composed of the following companies:

American Gas & Electric Service Corp. (in behalf of Appalachian Electric Power Co., Indiana & Michigan Electric Co. and Ohio Power Co., all of the American Gas & Electric System).

The Cleveland Electric Illuminating Co.

Columbus & Southern Ohio Electric Co.

The Dayton Power & Light Co.

Indianapolis Power & Light Co.

Louisville Gas & Electric Co.

Ohio Edison Co., Pennsylvania Power Co., members of the Ohio Edison System.

Southern Indiana Gas & Electric Co.

Monongahela Power Co., The Potomac Edison Co., West Penn Power Co., members of The West Penn Electric System.

I appreciate very much the opportunity to appear in these proceedings and to tell the committee about the project which East Central Nuclear Group is now working on in collaboration with two Florida companies, Tampa Electric Co. and Florida Power Corp. I am appearing primarily as a representative of the East Central Nuclear Group and shall give a general account of the project with which all of us are concerned. Dr. Walter H. Zinn, president of General Nuclear Engineering Corp., who has been serving as a consultant to the groups, is here to go into the technical details. Mr. William J. Clapp, president of the Florida Power Corp., is here to speak from the standpoint of his company and Tampa Electric Co., which, together, form the Florida West Coast Nuclear Group (FWCNG).

February a year ago, in a communication to the chairman of this committee in behalf of the same group of Ohio Valley area companies for which I am now appearing, I stated that we contemplated an intensive study and evaluation of 3 reactor concepts with a view to selecting 1 on which to carry out preliminary research to be followed by construction of a small prototype. I also stated that we were especially interested in reactor concepts which would lend themselves to high pressures and to high temperatures with resulting high thermal efficiencies in the turbine. This approach was directed toward attacking the problems of reduction of capital costs of the reactor and the rest of the plant, as well as reduction in cost of fuel and other operating expenses.

Our Ohio Valley group investigated these three concepts, along with several others suggested by the nuclear engineers and manufacturers with whom we consulted. Of those examined, one of the most attractive concepts was an advanced, gas-cooled reactor and this idea

also seemed to fit in best with the kind of objectives which our group had set. We knew, however, of the Florida Nuclear Power Group's proposal which was pending last summer and did not want to duplicate work the Florida companies might do. When, at the end of the summer, there were indications that the Florida proposal for a 136,000 kilowatt plant might not materialize as a project, we decided to take another look at the idea ourselves. In this process, as study and discussions proceeded during the fall, it appeared that we could work out a logical and mutually beneficial arrangement between our group and 2 of the 3 companies that constituted the original Florida organization. These two companies, Tampa Electric and Florida Power, were anxious to build a reactor in their State.

The location of a prototype in Florida, which is one of the highest fuel cost sections of the United States, rather than in the Ohio Valley, which is one of the lowest, makes a great deal of sense. The project in which we are now engaged, therefore, constitutes a natural program for the Ohio Valley area and the Florida companies to undertake. Mr. Clapp will explain in detail just what bearing the Florida fuel situation has on building a reactor in his part of the country.

In formulating the program it became clear that we should bring down the reactor size and we are now planning a prototype of approximately 50,000 kilowatt electric capacity. It also seemed appropriate to work out arrangements under which a major portion of the expenditures for research and development required to determine technical feasibility of the reactor will be provided by East Central Nuclear Group. Since the East Central Nuclear Group was formed to undertake just such a research and developmental program, we have been able in the months since last fall to make detailed plans for a project for an advanced, high temperature, gas-cooled, heavy water moderated, pressure tube reactor.

I shall refer a little later to the financial arrangements covering the undertaking, including the Government assistance that we need. But I should like to say now that the project represents an exciting opportunity for application of the philosophy of the companies in ECNG with respect to development of economical atomic power. The emphasis is on intensive research and development.

The reactor concept which is being pursued promises important steps toward competitive nuclear plants. The design anticipates higher thermal efficiency through higher temperatures and pressures. This is the same line of improvement we have followed successfully in achieving lower costs in conventional plants: higher thermal efficiency brings not only reduction in fuel costs per kilowatt-hour but also makes possible reduction in capital costs—savings which, as you know, are even more important in the case of atomic plants than conventional ones.

In addition, the gas-cooling feature of the reactor is expected to contribute much needed simplification. And a reactor aimed at solving the problem of utilizing natural uranium also offers the hope of cheaper fuel costs for a long time to come.

There is a further important aspect of the project which is closely in line with our philosophy. Our experience has shown that successful research and development requires the construction of prototypes. It has been our purpose to find a prototype reactor of the smallest

size, and therefore the smallest cost, that would give meaningful results for designing the larger atomic powerplants which will ultimately yield the greatest economies. But, in the present state of technology, the operation of any nuclear reactor, even of the advanced design we are pursuing, will involve substantial economic handicaps. The high fuel cost situation in Florida, which I have already mentioned, helps to minimize these economic handicaps but we do not expect that it will eliminate them.

The proposed program contemplates research, development, and construction of the 50,000 kilowatt prototype, including its operation for a minimum of 5 years. This station would serve as a prototype of a 200,000-kilowatt reactor for the future. The present plans, however, are limited to the 50,000 kilowatt prototype which, in the size planned, would require slightly enriched fuel. It is expected that a similar reactor of 200,000 kilowatts could operate on natural uranium.

The 50,000 kilowatt plant is similar in a number of respects to the one proposed by the Florida Nuclear Power Group under the third round power demonstration reactor program. We believe, however, that the reactor concept we now have represents a considerable technological advance in that it is planned to use advanced fuel technology so that the coolant temperature can be raised to make possible the achievement of steam conditions comparable to those in modern conventional plants.

East Central Nuclear Group and the Florida West Coast Nuclear Group submitted a joint proposal for the project to the Atomic Energy Commission on December 20 last year. A few days later I sent a copy of the proposal to the Chairman of this committee. After a number of discussions with the AEC and clarification of our groups of certain aspects of the proposal, the AEC advised us on February 3, 1958, that the proposal was accepted as a basis for negotiating a contract—contingent upon necessary action by this committee and appropriate legislation by the Congress.

The annexed tabulation summarizes the financial arrangements for carrying out the undertaking, including the financial assistance that the AEC would furnish. As the tabulation shows, the utilities (and primarily East Central Nuclear Group) and AEC will share, on an approximately equal basis, the costs of research and development. The Florida West Coast Nuclear Group would undertake the construction and operation of the prototype following successful conclusion of the research and development. Also, as indicated in the tabulation, except for waivers of charges for heavy water and for use of fuel, FWCNG would construct and operate the prototype with its own funds and at its own risk.

In carrying out the work, ECNG will administer the entire research and development program. It is expected that Dr. Zinn's General Nuclear Engineering Corp. will be the principal design agent and that Dr. Zinn will be the nuclear project engineer. It is also expected that American Gas & Electric Service Corp., of which I am president, will be principal design and construction engineers for the project.

We submitted our December proposal under the third round power demonstration reactor program. In so doing, however, we observed that a target date of June 30, 1962, for completion of the prototype could be realized only by an unusual combination of successful re-

sults in research, development, and construction. We thought there was a fair probability that the prototype could be completed by December 1962. But, taking into account the number of unknowns which needed to be explored in the research and development phase, the most realistic projection we could then make—even assuming negotiation of necessary contracts and commencement of work with all possible speed—would be an initial startup for the prototoype about June 1963. For this and possibly other reasons, too, we understand that legislative action is necessary to make our project possible.

The group which I represent, as well as the Florida West Coast Nuclear Group, believe strongly that this project promises to make an important contribution to the solution of the problem of competitive atomic power. The members of the groups convened within less than a week following receipt of the AEC letter of February 3 to determine what they might accomplish pending consideration of the matter by this committee and necessary action by the Congress. We decided to, and immediately did, authorize the expenditure of up to $720,00 to carry out the first stages of the program of research and development during the next 6 months.

Representative HOSMER. Mr. Chairman, I am confused as to whom "we" refers.

Mr. SPORN. To the East Central Nuclear Group, including also participation by Florida West Coast Nuclear Group, because Florida West Coast Nuclear Group, Mr. Hosmer, will also participate in the research and development.

Representative HOSMER. It is a combination?

Mr. SPORN. It is a combination.

The tabulation which I will show you later will make it quite clear.

Representative HOSMER. I was confused as to whether you were talking about your own company or the groups.

Mr. SPORN. Our two groups.

I want to point out that all members of the groups did this willingly but with the understanding that none of us would have an obligation beyond such 6-month period unless, within that time, authorizing legislation can be adopted and appropriations made available so that the Atomic Energy Commission is able to execute a contract with us.

The Commission has advised us that, if the necessary legislative authorization is adopted, it is prepared to negotiate provisions in a final contract pursuant to which project costs which we incur subsequent to February 3 will be credited to our share of the research and development program. But we are also now incurring such costs with the further understanding that this creates no claim against the Government in the event that, for any reason, contract execution does not take place.

I am very happy to report to the committee that I have verbal confirmation from Dr. Zinn this morning that the project which we authorized Dr. Zinn's organization to proceed with is actually underway. In other words, money is being spent on it right now.

We are confident of the technical soundness of our program. We are confident it will make a contribution to the common fund of knowledge in reactor technology. The East Central Nuclear Group and the Florida West Coast Nuclear Group are enthusiastic about the project. We are willing to spend large sums of our own money over the next

few years. In these circumstances, we are most hopeful that your committee will find the project sufficiently solid and worthwhile to support the necessary legislation.

Finally, I should like to speak about the nature of the commitment to the Commission with respect to the construction of the prototype after the necessary research and development is done. Construction will involve very large expenditures by the Florida companies; hence it is a matter of great consequence to them. I nevertheless feel that I should comment briefly on this matter because, insofar as ECNG is concerned, we would not be willing to put in some $6,500,000 in the preoperational research and development program, or to proceed with this project at all, if we did not think that the outlook for ultimate construction of the reactor is good.

Under the proposal, the AEC has the right to decide, after consultation with ECNG and FWCNG, whether or not the prototype is technically feasible. If the decision on technical feasibility is in the affirmative, then an economic test is prescribed for determining whether or not the prototype must be built. The test will be a comparison bewteen the estimated cost of power from the prototype and that from a conventional plant which would otherwise be built in Florida at about the same time that the reactor would be built. The size of the conventional plant to be compared has been fixed at 120,000 kilowatts. The economic comparison will be made on a basis which assumes conventional financing for the hypothetical, fossil fuel plant; but, for the prototype, 85 percent debt financing will be assumed, with consequent lower fixed charges. In other words, this comparison will in this respect be favorable to the atomic plant.

The comparison will also use the estimated average cost of the third, fourth, and fifth years of operation of the reactor when higher plant factor is expected to reduce unit costs.

What the proposal provides is that the Florida companies will be obligated to build prototype unless competent engineers, selected by mutual agreement of all the parties including AEC and using the formula just described, find that the cost of power from the prototype will exceed 150 percent of the cost of power from the assumed conventional plant. The estimates that we made in submitting our proposal showed cost of power for the prototype of 11.9 mills per kilowatt-hour as against 8.18 mills per kilowatt-hour for the conventional plant.

In making these estimates we used the conservative figure of $12 per gram for the plutonium credit.

If estimates of this kind prove out after the research and development work is done, then the 150 percent test will be more than satisfied. Even under these circumstances the Florida companies would incur a cost burden of approximately $1 million a year—which they would not experience with the conventional plant—for the assumed 20-year life of the prototype. They should not, in my opinion, be required to assume any larger burden than that.

I realize that there may be matters of importance as well as matters of detail not covered by my statement nor by those of Dr. Zinn and Mr. Clapp which the committee may wish to inquire into in connection with legislation relating to our project. All of us are, of course, prepared to testify in any proceedings on legislation at the committee's pleasure.

24041—58——26

Now I should like to take a minute or two to review the estimates of cost.

It will be noticed that the estimates of cost are broken down among three organizations along a series of functional operations:

The preoperational research and development estimates the AEC's expenditures at $6,097,000, Florida west coast nuclear group's at $420,000, and east central nuclear group's expenditure at $6,593,000, a total of $13,110,000.

The design and construction of the prototype is estimated at $25,885,000, and that would be put up entirely by Florida west coast nuclear group.

I might add, parenthetically, that this figures at $518 per kilowatt of capacity. But I also would like to point out that this is $518 per kilowatt of capacity on top of the research and developmental expenditure of almost the same amount, which would not go on the books of the Florida west coast nuclear companies because it will have been expended for research and development.

So if you look at the figure at the lower-right-hand side you will see that the figure of total expenditures to bring into being the 50-megawatt prototype is in excess of $1,000 a kilowatt, and we think that is a realistic figure.

Now to go back to the table, there is a postoperational research and development expenditure, primarily in fuel elements and related matters, of which the Commission would furnish $3 million and east central nuclear group $2 million, for a total of $5 million. We have in here the charge for the waiver of fuel and heavy water during the first 5 years of operation, and that would be, of course, a waiver by the Atomic Energy Commission, and we have added that as a contribution by the Commission in the amount of $800,000.

Finally, we have the excess operating costs during the first 5 years of operation which would be borne by Florida. This is the excess of operating costs above conventional costs which excess amounts to $5,426,000.

So that this adds up to an expenditure, including waiver of fuel and heavy water charges, by the Atomic Energy Commission of slightly under $10 million, an expenditure by the Florida west coast nuclear group of $31,731,000, and an expenditure by the east central nuclear group of $8,593,000, for a total of $50,221,000.

I want to point out that there is a further commitment. In the event we finish with the expenditures in research and development of the amount indicated in the table that I have just discussed and we still have not completed our research and development, the Atomic Energy Commission has an option, by agreeing to pay half of the overrun costs, to require the companies to proceed with further research and development work up to a maximum of over $5 million, and the Atomic Energy Commission would then take half of that, estimated now at $2,549,000, and east central nuclear group would take the other half, and east central nuclear group also estimates that its expenditures in administrative and assigned personnel costs would be almost an additional million dollars. So there is a pledge of another $3½ million, roughly, by the group for research and development in case the estimated amount of research and development of $13,110,000 proves inadequate to complete the job.

Chairman DURHAM. Thank you very much, Mr. Sporn.
Since this is a related matter, I believe we will defer the questioning.
(The table referred to follows:)

Estimates of cost

[In thousands]

	Atomic Energy Commission	Florida west coast nuclear group	East central nuclear group	Total
Preoperational research and development	[1] $6,097	[1] $420	[1] $6,593	[1] $13,110
Design and construction	0	25,885	0	25,885
Postoperational research and development	3,000	0	2,000	5,000
Waiver of fuel and heavy water use charges during 1st 5 years of operation	800	0	0	800
Excess operating costs during 1st 5 years of operation	0	5,426	0	5,426
Total	9,897	31,731	8,593	50,221

[1] AEC's contribution of $6,097,000 includes up to $1,000,000 for work to be done in AEC facilities. The Florida west coast nuclear group and East central nuclear group contributions of $420,000 and $6,593,000, respectively, include $170,000 and $1,745,000, respectively, for administrative costs and costs of assigned personnel. In the event of an overrun in the preoperational research and development costs, AEC has the option, by agreeing to pay half of the overrun costs, to require the companies to proceed with further research and development work up to a maximum of $5,098,000; in that case, AEC's share of the overrun would be up to $2,549,000, while the utilities' share would be a like amount plus an additional amount up to $958,000 for administrative costs and cost of assigned personnel.

Mr. SPORN. I think Mr. Clapp, Mr. Chairman, will state the Florida position. I will stand by for any questioning, Mr. Chairman.
Chairman DURHAM. Thank you.

STATEMENT OF W. J. CLAPP, PRESIDENT, FLORIDA POWER CORP.

Mr. CLAPP. Mr. Chairman and gentlemen, we thank you for the privilege of appearing before you today.

My name is W. J. Clapp, and I am president of the Florida Power Corp., St. Petersburg, Fla. I am here today representing the Florida west coast nuclear group, which is composed of the Tampa Electric Co., Tampa, Fla., and the Florida Power Corp. The statement that I am making is on behalf of these two companies, and is confirmation of the statement that Mr. Philip Sporn has just made regarding our participation in a joint venture with the east central nuclear group.

The two Florida power companies combined serve a population of a million and a quarter people, over an area comprising 33 of the 67 counties in the State of Florida. Our transmission systems have been interconnected for years, and the two companies' service areas are immediately adjacent to each other on the west coast of Florida. We have a combined electric-generating capability today of 1,030,000 kilowatts. Our loads have been doubling every 5 years, and we estimate that our combined powerplant facilities will total 2,075,000 kilowatts by 1963.

The two companies, as of the end of 1957, had a total investment of $343,627,000 to serve the more than 375,000 customers on our lines.

To keep up with the rapid growth of Florida, we have had to expand for new construction during the past 5 years a total of $190 million. Between now and 1963 we estimate the two companies will have to spend an additional sum of $321 million to keep up with the continued growth.

Our two companies have had a continuing interest in nuclear power, having in 1955 organized a study group—along with Florida Power & Light Co. This group subsequently became the Florida nuclear power group, which group submitted a proposal to the Atomic Energy Commission, as explained to your committee in testimony by Mr. W. C. MacInnes, president of Tampa Electric Co., February 27, 1957. After considerable discussion with the staff of the Atomic Energy Commission on this proposal, we were advised in the fall of 1957 that the proposal of the Florida nuclear power group would not meet the requirements of the third round power demonstration program.

Since the Tampa Electric Co. and Florida Power Corp. which, as I have stated, are closely interconnected and operate in contiguous territory, we continued to explore the possibilities of establishing a nuclear plant in our section of Florida. Consequently we were delighted to receive a proposal from the east central nuclear group to cooperate with them in the development of the type of reactor that we had had in mind. The member companies of the east central nuclear group have some of the most efficient powerplants in the world, and are located in an area where fuel costs are perhaps the lowest in the country. Their interest under these circumstances is certainly an indication that this type of reactor has real possibilities to help alleviate our fuel cost situation here in Florida.

Florida has no known source of fossil fuels available in any quantity. What little hydro power is available, has already been developed. As yet, no major natural gas pipelines have been built into the State except in a small portion of north Florida. Coal has to be shipped quite a distance and is not, as yet, a major source of boiler fuel. Essentially the State's fuel economy is based on oil, which has to be transported a considerable distance, resulting in relatively high fuel costs. The advancement in the art of oil refining has resulted in more of the crude oil being manufactured into higher-profit petroleum products, leaving less and less residual, at a constantly increasing cost.

The posted price of residual fuel oil, delivered in Tampa, has gone from a low in 1939 of 85 cents per barrel—gradually increasing through the years—to a price today of $2.54 per barrel. With the ever-increasing cost of petroleum products and the rapid growth of electric loads in Florida, we naturally are concerned about the future source and future trend of prices for competitive fuels. In view of this, we are sincerely interested in the research and development program of nuclear reactors that show the greatest promise for the lowest fuel cost.

Cost of construction of powerplants in Florida is among the lowest in the United States; but even if the prospects of higher capital costs for a nuclear plant are apparent, we feel that the plant we have in mind is justified because of the possibility of obtaining a low-cost fuel source for our rapidly growing area.

My major purpose in appearing before you gentlemen today is to give you assurance that the Tampa Electric Co. and the Florida Power Corp. are sincere in their determination to build a nuclear plant, as outlined to you by Mr. Sporn, and to participate in the research and development program jointly with the Atomic Energy Commission and the east central nuclear group.

The knowledge, experience, and enthusiasm which Dr. Walter H. Zinn and his group of scientists of the General Nuclear Engineering Corp. have demonstrated for the future of nuclear power, have played a large part in inspiring the determination of the Tampa Electric Co. and ourselves to proceed with a nuclear plant. This engineering concern being located in our company's territory, and our using them on this project will certainly expedite all phases of this program.

Dr. Zinn will now continue this presentation.

Chairman DURHAM. Thank you very much, Mr. Clapp.

We will now hear from Dr. Zinn.

STATEMENT OF DR. WALTER H. ZINN, PRESIDENT, GENERAL NUCLEAR ENGINEERING CORP.

Dr. ZINN. My name is Walter H. Zinn. I am president of the General Nuclear Engineering Corp., of Dunedin, Fla. Our company is the proposer and designer of the particular reactor powerplant which the east central nuclear group and the Florida west coast nuclear group have chosen to develop in their search for economically acceptable nuclear power. In my opinion, the most useful thing I can do today is to repeat to you the basic arguments which have led us to believe that the high-temperature gas-cooled reactor, fueled with natural or near-natural uranium, ultimately has the best chance of competing in places where conventional power is very cheap. Obviously, the east central nuclear group could be interested only in putting its money into a development project which has such promise, since their generating area produces some of the lowest-cost electricity in the United States.

DESCRIPTION OF THE PROPOSED REACTOR

Briefly, the reactor proposed has these characteristics: Gas, either CO_2 or helium, at a pressure of 500 pounds per square inch, is pumped through channels containing fuel elements. In passing through the reactor, the gas is heated to a temperature of 1,050° F. removing 180 megawatts of heat from the reactor. I am speaking of the prototype here. The hot gas passes from the reactor to heat exchangers where steam at a temperature of approximately 1,000° F. and a pressure of 1,200 pounds per square inch is generated. In its temperature and pressure, this steam approaches what is conventionally used and therefore can be delivered to a turbogenerator of standard design. The fuel in the reactor must withstand temperatures considerably in excess of the exist gas temperature, which fact makes it impossible to use uranium metal. Fortunately, in recent years uranium in ceramic form, mainly UO_2, has been developed for the water reactors and has been shown to have quite phenomenal resistance to radiation damage. It is proposed to use the same material for the gas-cooled reactor fuel. The fuel channels in the reactor consist of tubes confining the gas. The moderator, which is heavy water, surrounds the tubes and is kept at a temperature below its boiling point. Therefore, the reactor does not use a pressure vessel and is described as the pressure-tube type.

The prototype reactor proposed requires uranium enriched to 1.15 percent. A large-scale reactor would operate satisfactorily entirely

on natural uranium. The difference is due to the fact that the prototype reactor is physically small, having a core diameter of 10 feet, thus permitting too many of the neutrons to leak from the machine into the shield. The size of the prototype reactor has been chosen so that, in all other respects, scale up to a reactor of 200 energy megawatts will not require the solution of new basic problems or the development of new equipment components.

FUEL COST

Fuel costs for nuclear plants should be low. Low fuel cost, if realized, offsets the higher relative capital cost which nuclear powerplants apparently must contend with for some time.

I wish to comment on the factors of greatest importance to fuel cost, namely, the net burnup cost, the fuel element fabrication cost, and the irradiated fuel chemical processing cost.

NET BURNUP COST

The net burnup cost is the difference between the value of the uranium placed into the reactor and the value of the uranium plus plutonium which is discharged. The net burnup cost will be least for natural uranium fuel simply because the U–235 which is burned is the cheapest U–235 available. U–235 which is the product of an isotope separation plant must be more expensive, but is indistinguishable as far as ability to yield energy is concerned. The following table illustrates my point by contrasting the net burnup cost for two reactors: One fueled with natural uranium and the other with uranium enriched to 3 percent in the U–235 isotope. Three percent enrichment is typical for some of the pressurized water reactors.

Enrichment	Natural	3 percent
Burnup assumed, MWD per ton U	4,000	10,000
Contained U–235 per kilogram of fuel, grams	7.1	30
U–235 consumed per kilogram of fuel, grams	4.0	12.3
Pu produced per kilogram of fuel, grams	3.0	7.3
Cost of U–235 consumed per kilogram of fuel	$38.0	$180
Value of Pu produced per kilogram of fuel (at $12 per gram)	$36.0	$88
Net fuel burnup cost per kilogram of fuel	$1	$103
Electricity produced by kilogram of fuel, kilowatt-hour	2.9×10^4	7.3×10^4
Net fuel burnup cost, mills per kilowatt-hour	0.07	1.4
Fuel burnout cost without any Pu credit, mills per kilowatt-hour	1.3	2.6

The table shows that with respect to net burnup cost, natural uranium may enjoy as much as a twenty fold advantage. Now, of course, the mills per kilowatt-hour figures given in the table are entirely dependent on the burnup which is assumed to be possible to obtain in the two cases. It is our judgment that there is an equally good probability of obtaining 4,000 MWD per ton in a natural uranium reactor as there is of obtaining 10,000 MWD per ton in an enriched uranium reactor.

In the two cases, the factor which ultimately limits the burnup of the fuel in the reactor probably will not be the same. For the enriched uranium reactor, the limiting factor probably will be radiation damage and will not be a loss of reactivity of the reactor due to burnup of fissionable material. In the natural uranium reactor, the most

likely cause of the limitation on burnup is the loss of reactivity due to the consumption of fissionable material. In the latter case, the use of a small amount of enriched uranium, or, putting it another way, slight enrichment of the fuel, adds reactivity and materially lenghthens the life of the uranium in the machine and therefore increases the burnup. It is this fact which causes us to say that the lowest net burnup cost will be achieved with either a natural or very slightly enriched uranium reactor.

The reactor under consideration in the present proposal uses heavy water for the moderator. Although there are some engineering reasons for prefering a liquid moderator, the overriding reason for using heavy water is that more spare reactivity is available with this moderator than with any other, which makes operation of the reactor on natural uranium attractive. Our calculations show that a burnup of natural uranium fuel in heavy-water-moderated reactors in excess of 4,000 MWD per ton is feasible.

FABRICATION COSTS

We believe that the present rather high fabrication costs for solid fuel elements in the United States can be reduced by changes in the specifications for the fuel elements. Of course, of equal importance would be a sizable increase in volume of fuel element manufacturing, but our present project cannot help on this point.

The reason for using gas under high pressure is to improve the heat transport. Even so, gas cooling cannot match liquid cooling. This disadvantage is somewhat offset by the fact that the coolant passages for the gas must be relatively large, and large coolant passages permit the specification of less precise manufacturing tolerances, and will lower fabrication costs. The fuel element jackets, which in this reactor are beryllium metal or alloy steel, or possibly a ceramic material, must contain the fission products. The tube-type reactor permits the convenient detection of a very small defect in the jacket and permits corrective action to be taken before any appreciable leakage of fission products into the coolant gas can occur. The expense connected with the testing of the fabricated fuel elements to be sure that the jackets contain no defects, we believe, will be materially lessened because of the favorable situation with respect to failure detection in a tube reactor. It should be noted that the coolants and the basic fuel materials proposed are entirely compatible, and no serious problem with respect to corrosion is expected.

In connection with manufacturing costs, we note that the use of natural uranium would permit some saving because of the avoidance of criticality problems in the various operations which must be performed. Criticality problems, of course, are directly related to the degree of enrichment.

CHEMICAL PROCESSING OF SPENT FUEL

The Atomic Energy Commission has published prices for the chemical processing of spent fuel, including the separation and decontamination of plutonium. So far, at least, there is apparently no disadvantage associated with any particular form of fuel, so all reactors can be considered alike with respect to chemical processing costs.

Reactors which are fueled with natural uranium or with slightly enriched uranium do have the possibility of avoiding the chemical processing step altogether. For such reactors, at the time of discharge the value of the remaining U–235 in the fuel is essentially zero, and, therefore, the economic desirability of processing the fuel is merely a balance between the value of the plutonium recovered and the cost of doing the work. If, in the future, it should be found that plutonium does not, for power purposes, have a value as great as $12 per gram, or in the event that it is found that chemical processing costs materially more than the prices now published by the AEC, a reactor which could avoid chemical processing may have a substantial advantage. The reactor type proposed here does have such a future possibility.

CAPITAL COST

Without actually having built the reactor, I expect that statements about capital cost will be received with considerable skepticism. I wish, however, to comment on several features of a reactor which play a leading role in establishing the cost of the plant. The specific power of a reactor is the rate at which heat is removed from each unit of fuel. It is usually stated in terms of megawatts of heat per ton of fuel. Generally speaking, we can expect that the capital cost per kilowatt of electrical capability of the plant will be high when the specific power is low, and vice versa. The reason is that low specific power means that there will be a large inventory of fuel in the reactor and that all of the associated parts, such as coolant channels, moderator volume, shielding, foundations, and building, will be large, and therefore will lead to a large capital cost. Gas-cooled reactors, so far as they have been developed, suffer from the disadvantage of having a relatively low specific power. For instance, the most advanced British plant, namely, that at Hinkley Point, will have a specific power of 2.6 megawatts per ton of fuel. Any of the water-cooled reactors, such as the boiling water reactor or the pressurized water reactor, has a specific power in the neighborhood of 15 megawatts per ton of fuel. In order to correct this disadvantage, the gas-cooled reactor proposed in this project uses the gas at a high temperature and a high pressure, with the result that the specific power can be raised to about 10 megawatts per ton of fuel. To accomplish this desirable result, the fuel will have an extended heat transfer surface and the surface temperature will rise to 1,200° F. The high gas pressure for large-scale reactors makes the construction of an enveloping pressure vessel impossible. The high temperature of the fuel dictates the use of nonmetallic materials. The high pressure and the high temperature of the gas also affect the size of the equipment in the primary coolant circuit, acting to reduce the size and cost per unit of energy conveyed. Finally, the high temperature raises the overall efficiency of the plant, thus producing more electricity for each dollar invested in the plant.

Gas-cooled reactors have one important capital cost advantage with respect to sodium or water-cooled reactors. This is the corrosion situation which permits the use of ordinary steel for the large pipes, pumps, heat exchangers, and other primary circuit parts rather than

special alloy steels. Especially where large-scale plants are involved, the choice of kind of steel can have a substantial effect on the cost of the plant.

OPERATION AND MAINTENANCE

Experience to date indicates that the radioactivity associated with the circulating gas of a gas-cooled reactor is entirely minor. Of course, I refer here to the British experience.

Relatively little, if any, shielding is required and, above all, access to all parts of the equipment immediately after shutdown is possible. The usual methods of maintenance can be used. We think that for large electric-generating stations the possibility of carrying out maintenance in a routine fashion is of great importance. It is therefore a goal of the development program of this reactor to find fuel element jackets which will operate at the temperature specified and which will not leak fission products. The primary coolant circuit will not be radioactive.

As was mentioned earlier, the tube reactor lends itself particularly well to the early detection of failures in the jackets of fuel elements. The future development of this class of reactors to levels of performance beyond what is set out here will depend very much on the success in obtaining fuel elements which can operate at still higher temperatures, but which, at the same time, contain the fission products.

RESEARCH AND DEVELOPMENT PROGRAM

The research and development program which will be undertaken in this project contains many problems which must be solved in order to set the final specifications of the plant. Two items, however, are of overriding importance. A pressure tube must be developed which has low neutron absorption and which can withstand neutron and gamma irradiation for a long period of time. Metallic tubes have functioned successfully in reactors for many years. For this reactor, the service conditions are more severe. In our judgment, there is a very good chance that suitable pressure tubes can be made and that appropriate tests will show that they will have adequate life in the reactor. The second problem is the high-temperature-fuel element. There, also, recent results indicate that with further research and development effort a suitable structure will be found. What I really mean to say is that to solve the principal technical problems in this reactor requires a major research and development effort, but it does not depend on some unspecified and merely hoped-for breakthrough in technology. We think that the overall result will be a highly desirable reactor and one which must be added to the program of power reactor development in the United States; not only because it promises to advance us toward the goal of economically competitive nuclear power in this country, but because, in its natural uranium version, it may prove to be highly attractive to the electric industry in foreign countries.

Chairman DURHAM. Thank you very much, Doctor.

From your statement, I assume you have already done a lot of work on this reactor.

Dr. ZINN. We have had a year of waiting, as you know, and we have been doing some work in the meantime.

Chairman DURHAM. This is a change in concept from when you first started out; is is not?

Dr. ZINN. Yes, sir. There has been one thing added, and I would like to state added at the request of the Ohio Valley group, the east-central nuclear group. We have materially raised the temperature of the gas in order to get higher efficiency and the other advantages I mentioned. Just as soon as we had to do that, we had to give up using metallic uranium for the fuel and go to ceramic fuel.

This changes the whole design of the machine. It is a more advanced concept than we were proposing a year ago.

Chairman DURHAM. What difference in temperature does that give you?

Dr. ZINN. We raised the exit gas temperature from about 670° Fahrenheit to 1,050° Fahrenheit.

Chairman DURHAM. That is quite a difference.

Dr. ZINN. It eliminates the possibility of using uranium metal and makes a large difference in the design of the machine. It makes it better if you can do it.

Chairman DURHAM. Do you think it is worthwhile for us to continue the natural-uranium idea in this country?

Dr. ZINN. I certainly do.

Chairman DURHAM. I mean with no enrichment. I am talking about a natural-uranium reactor.

Dr. ZINN. I want to be very careful in explaining why I say natural uranium or very slightly enriched uranium. I want to separate those materials from, let us say, higher enrichment.

When I say "very slightly enriched or natural uranium," I mean a fuel which, in passing through the reactor, has its uranium 235 content reduced well below natural uranium, so that most of the uranium which is burned is really the uranium 235 in natural uranium. That is the cheapest fuel you can have.

I could give a number, for instance, a 3-percent enriched uranium reactor starts out with about 30 grams of uranium 235 in a kilogram of fuel and after a long exposure end up with 18 grams in there, of which only 7 originally were the natural uranium 235 grams. So you have not burned any of the cheap uranium.

When I say "slightly enriched," I mean something which starts out with 9 grams per kilogram and you burn it down to 3 grams per kilogram.

Most of the material that was burned there was the cheap uranium 235. This is a basic fact that you cannot get away from.

Chairman DURHAM. You mentioned in here that this has possibilities of being helpful in carrying out this foreign program that we visualize and hope to do something about.

Would you elaborate a little bit more on that?

Dr. ZINN. In order to elaborate on it, I would have to state what some of the problems are in interesting foreign companies who generate electricity. In some of the reactors that we now offer——

Chairman DURHAM. In other words, you feel that this has a great advantage over anything that we have to offer them at the present time?

Dr. ZINN. In a certain context in the foreign field, a natural-uranium reactor is more attractive. The context is very simple.

Natural uranium will be the first material—and I think this cannot be disputed—which will achieve some sort of normal commercial market. It will be available from a number of sources. It probably will be produced competitively. Enriched uranium for quite a long time will not be produced competitively. As a matter of fact, the only sources in sight are plants owned and operated by governments. Business people are the same the world over. They want freedom from government control whether it is in Europe or some place else.

Chairman DURHAM. I can see your point there.

Of course, in the position we are at the present time, we are not competing with uranium in the foreign market. Of course, I understand that Canada is exporting natural uranium that probably comes from South Africa and other places. It is natural for those people to go to the best supply of fuel. I would if I were to invest in reactors. I would not want the price controlled by one country.

Dr. ZINN. I think this is the basic reason why some foreign countries, and perhaps nearly all, will make a determined effort to get some natural-uranium reactors.

Chairman DURHAM. I do not think you are going to get much business over there unless this fuel problem is solved in one way or another. I believe that is the reason they are going to natural uranium.

Dr. ZINN. I do not want to give the impression that I think they will go entirely to natural uranium. They will make the best purchase, if I may say so, that they can. I doubt that very many countries would say now they will decide to rely entirely on enriched uranium which must come from the United States. They would not make that decision now.

Chairman DURHAM. This is a very intriguing concept that you have come up with, and the only thing I would say is this: I believe you are realistic in your capital costs. You have come up with a higher figure than anybody has who is building a reactor. You have put a capital cost here of about $1,000 per kilowatt.

Dr. ZINN. I want to be clear that half of that is research and development and half is construction.

Chairman DURHAM. As far as that is concerned, it costs that whether it is research and development or what it is. I realize you have to take it out.

Dr. ZINN. I do not apologize for the high estimate. You know this business better than I do, perhaps, on capital costs. You have heard more about it.

Chairman DURHAM. Nobody in this country knows any more about reactors than you do.

The other thing you mentioned, also, was that this was dependent on this committee or the Congress changing the act which would make this permissible. What do we have to do to the act to permit you people to build? Is it to give you more research and development funds?

Dr. ZINN. I would suggest that Mr. Sporn answer that question.

Mr. SPORN. I think, Mr. Chairman, it is only to put in an amendment to permit this reactor, which is estimated to be completed by June 30, 1963, to be included under the third-round demonstration program.

Chairman DURHAM. You would not necessarily have to do that because it would come in the program authorization of this year as a particular item.

Mr. SPORN. I think this is the one thing that is in its way, Mr. Chairman, the fact that we cannot really say that we believe it can be finished by June 30, 1962, and also to permit the Commission to extend the privileges of heavy water use without charge to a reactor that is intended in the final size to be natural uranium, but which in this prototype, for reasons which Dr. Zinn explained, will not be quite operative with natural uranium. It will be slightly enriched. This is the other item that is bothering the Commission.

I believe, Mr. Chairman, that the Commission intends, or possibly has already done so, to submit a suggestion for the necessary legislation to this committee. We hope if it has not been done that it will be done very soon. We believe it will be.

Chairman DURHAM. It will come up in the regular authorization bill, of course.

Mr. SPORN. We believe the Commission is submitting a separate request for the necessary legislation.

Chairman DURHAM. The statement that they made, I believe, was that heavy water was not to be used except with a natural uranium reactor.

Mr. SPORN. That is right. The Commission's third-round invitation stated the waiver of use charges for heavy water would be considered for reactors designed to use natural uranium.

Chairman DURHAM. That is a problem.

Mr. SPORN. Yes, sir.

Chairman DURHAM. I believe that could be changed by administrative procedure. It is not necessarily a matter that would have to come before Congress.

Mr. SPORN. It certainly could be changed by the Commission and I would think, if the joint committee agrees, that such a change would not be stretching beyond what should be a permissible limit.

Chairman DURHAM. You would like to know by act of Congress that you can get the water and not be subject to change of ideas?

Mr. SPORN. Yes. It is also a question of having the committee and the Congress fully aware of what is being proposed.

Chairman DURHAM. Would someone tell me what power costs in Florida at the present time?

Mr. CLAPP. Of course, this estimate is based on 8.18 mills. That includes fixed charges and so forth out of the conventional plant.

Chairman DURHAM. Is that what you are selling power for today?

Mr. CLAPP. No.

Chairman DURHAM. What are you selling power for?

Mr. CLAPP. That is at the bus bar at the plant.

Chairman DURHAM. What do you get today per kilowatt-hour per mill?

Mr. CLAPP. Average for all uses industrial is around 1.3 mills or rather 1.3 cents, and then the domestic and commercial are on up twice that and better in some cases. It would probably average nearer 3 cents for the domestic and a little bit higher than that for the commercial. That includes, of course, the additional facilities for the distribution from the bus bar over to 20,000 some miles.

Chairman DURHAM. Has any comparison been made in the cost per kilowatt-hour of a nuclear reactor and a conventional type plant operating as of today?

Mr. CLAPP. Yes. I believe it was brought out in the testimony that a conventional plant today of 120,000 kilowatt units, the bus bar costs, including fixed charges would be 8.18 mills.

Mr. SPORN. Mr. Chairman, my company made that estimate and we think it is a very realistic and fair estimate. It can be done for that figure without question.

We also think, as we have testified, that the 50 mega-watt nuclear power cost would be slightly under 12 mills.

Chairman DURHAM. You would not be so far apart.

Mr. SPORN. We would come within that 1½-to-1 ratio, Mr. Chairman.

Chairman DURHAM. Mr. Hosmer, do you have any questions?

Representative HOSMER. Yes.

Dr. Zinn, the temperature drop in your heat exchanger coolant would amount to about 50°?

Dr. ZINN. Yes, that is our present estimate. It takes detailed design to say what you want to do because the size of the heat exchanger is involved and you may want more.

Representative HOSMER. Were you here this morning when Dr. de Hoffman was testifying?

Dr. ZINN. No, I was not.

Representative HOSMER. Are you familiar with their gas-cooled-reactor concept?

Dr. ZINN. I am afraid I am not.

Representative HOSMER. From what I could gather they are going to take a temperature rise in a reactor of about 300° under their concept.

Dr. ZINN. Yes, so does this reactor. We take a rise somewhat more than that.

Representative HOSMER. Of the coolant?

Dr. ZINN. Yes.

Representative HOSMER. Your coolant goes into the heat exchanger at around 1,050.

Dr. ZINN. Yes.

Representative HOSMER. And your steam is 1,000?

Dr. ZINN. Yes. This is possible. This is probably the limit on what you can do on the steam.

Representative HOSMER. Where do you use that other temperature?

Dr. ZINN. You use other heat for feed water heating and so on. It is a fairly complicated cycle.

Representative HOSMER. You do, in your reactor, however, approximate the increase in heat of the coolant that deHoffman's idea does?

Dr. ZINN. Yes. Our calculations are based on a somewhat greater rise than the 300 you mention. The inlet temperature to the reactor at the optimum point is one of the most complicated things I know. It is not great science but it is high-class engineering.

Representative HOSMER. He said he was going to operate it around 1,400 degrees. You said you are going to operate around 1,200.

Dr. ZINN. That is right. The surface-fuel temperature we speak of is around 1,200° F.

Representative HOSMER. And your coolant is less than that?

Dr. ZINN. Yes. The coolant temperature has to be lower than that, because you need the drop to get the heat into the coolant. The very center of the fuel elements will operate at about 3,000° F. That is not very high for oxide-fuel elements.

Representative HOSMER. I think his concept was based on a greater difference in heat of the coolant than yours. Am I right or wrong, or are you familiar with it?

Dr. ZINN. I have not familiarized myself, or had a chance, with their detailed design, or their design, so I do not know.

Representative HOSMER. What I was trying to get at is, if their element design proves superior to yours, their element could be put in your reactor.

Dr. ZINN. I certainly would be delighted to do it, or to consider that of any other manufacturer who thinks he knows how to make a fuel element.

Representative HOSMER. You are anxious to get this job done and you do not care whether you father it or not.

Dr. ZINN. We do not manufacture anything. What we are interested in is getting the very best high-temperature fuel element we can imagine. We think the basic material is in sight because of the work that has been done in the water-cooled reactors, which has been very fine work.

Representative HOSMER. And because of these devlopments in ceramics, too?

Dr. ZINN. Yes. Now we need to add a jacket. That is the problem. We do not feel, and I do not believe the power companies feel, that a highly radioactive gas circuit is going to be a cheap one or an easy one to maintain.

Mr. SPORN. As to where the relatively low-grade heat goes in below a thousand, of course, the 1,000° is the superheat temperature. But the saturated temperature of the same steam is of the order of 525°, and a great deal of heat is necessary just to convert the water from the water phase into the steam phase.

Representative HOSMER. I did not understand it was a two-stage affair.

Mr. SPORN. It is the exit temperature we are talking about.

Representative HOSMER. Mr. Clapp, may I ask you this: Your companies have a tremendous job on their hands of doubling the capacity every 5 years. This whole atomic thing sounds like it has possibilities, but there is no definite peg to hang your hat on. What impelled you to get into this, with the job you already have down there of expanding your system?

Mr. CLAPP. When you realize that every pound of fuel or drop of oil that we burn has to come from the oilfields all the way across the gulf and be transported in several instances inland quite a distance before it gets to Florida, and that our whole State's economy is dependent on that one source of fuel, we feel that we need to get into this program and have the experience so that when the art is advanced to the point where atomic energy is feasible economically we will not be behind the rest of the country, because, with the higher fuel cost area such as we have, we need to be ahead of the industry.

Representative HOSMER. Is your apprehension more with respect to the cost of conventional fuels or with respect to the actual availability?

Mr. CLAPP. Actually, cost primarily, because, as I say, back in 1939 we were paying as low as 85 cents a barrel for fuel and today it is costing $2.54. It has been as high in the intervening time as $3.05 a barrel.

Representative HOSMER. You see the conventional market quickly pricing itself above the atomic.

Mr. CLAPP. Yes. Frankly, it is getting difficult to get an oil company to quote us on a supply of oil because there is less and less of this residual fuel left. As long as they can make higher priced products out of the crude, they are not too interested in selling residual.

Representative HOSMER. You have answered my question.

Now I would like to ask Mr. Sporn: The east-central nuclear group is putting up in excess of $81½ million?

Mr. SPORN. That is right.

Representative HOSMER. This is a group of utility companies, is it?

Mr. SPORN. This is a group all of utility companies.

Representative HOSMER. You are not getting anything out of this except the experience.

Mr. SPORN. Know-how.

Representative HOSMER. They own the plant.

Mr. SPORN. We will get nothing but knowledge, which will go into the public domain, by the way.

Representative HOSMER. That answers that part of the question. I only have one more. In this test as to whether to build a prototype or not, the comparison with a conventional plant will be a comparison with a 120,000-kilowatt plant.

Mr. SPORN. That is right.

Representative HOSMER. Whereas your prototype a 50,000 kilowatt?

Mr. SPORN. That is right.

Representative HOSMER. Even if the 50,000-kilowatt plant were a conventional one, it would be at a disadvantage in any such comparison, would it not, because of the fact that the larger the plant the less the cost per kilowatt?

Mr. SPORN. The atomic plant would be at a lesser disadvantage, Mr. Hosmer, against the 50,000 conventional plant, because the conventional plant of 50,000 kilowatts would cost more per kilowatt than the 120,000-kilowatt plant.

Representative HOSMER. Even a nuclear plant of a smaller size is at a disadvantage of some sort.

Mr. SPORN. Yes.

Representative HOSMER. So your statement is not entirely correct, that this comparison basis is favorable to the nuclear plant.

Mr. SPORN. I think it is. From that point it is not, but I want to point out what we have clearly spelled out or what I tried to spell out in my testimony that, in figuring the cost of an atomic plant, we figured a special capital cost consisting of 85 percent debt which eliminates a large part of the tax component in the fixed charge. In other words, atomic power will be heavy on its capital cost and, there-

fore, has the advantage as against a plant that would be financed in the conventional manner.

Representative HOSMER. Why did you develop such a complicated formula?

Mr. SPORN. It is really not complicated. We tried to make sure that what we believed was the burden that the Florida companies felt they could assume at the present time, which was, roughly, a million dollars a year would be approximately the limit to which they would be subjected during this test period. They certainly could not, and we did not feel there was any equity in asking them to make a completely open commitment. Companies several times their size I do not think could have made a completely unlimited commitment. In other words, it was to put some limit on how far they would be committed to really carry out the project.

Representative HOSMER. There is no joker in this comparison?

Mr. SPORN. There are certainly no jokers, and there is no tongue-in-cheek word in any part of this project, Mr. Hosmer; I can assure you of that.

Representative HOSMER. I was quite sure there was not, but I wanted you to say that. There is one other question on that specific point. Who would apply this test? Would it be you or the AEC?

Mr. SPORN. The test would be applied by a group of independent consulting engineers which we would set up by agreement with the Commission. The Commission would have a hand in setting them up.

Representative HOSMER. It would be a third party.

Mr. SPORN. Yes. We have lots of able and competent engineering organizations of fine integrity in the country.

Representative HOSMER. I wanted to know whether one party was going to be the jury and the judge.

Mr. SPORN. No, sir.

Mr. CLAPP. The 120,000-kilowatt units, Mr. Hosmer, that is the kind of plants both Florida companies are installing.

Representative HOSMER. Thank you.

Chairman DURHAM. What is the difference between this plant and the Carolinas-Virginia plant?

Dr. ZINN. In many respects they are alike. The Carolina-Virginia group is proposing to use heavy water as a coolant to remove the heat from the fuel. This reflects itself mainly in a temperature effect. It is a low-temperature reactor whereas this is a high-temperature one. In other respects they are very much alike because they both try to aim at natural-uranium operation and both use pressure tubes.

Chairman DURHAM. I believe that is a 20,000—what size is it?

Dr. ZINN. Yes. It is a little less than that. I might make one more comment on the matter of the size of this plant. It was not chosen on the basis of financing or anything of that kind. It was an estimate on our part, the nuclear engineers, of what is the smallest size gas-cooled, heavy-water-moderated reactor that makes overall sense. We have to deal here with the fact that if you make it too small you lose the chance of finding out certain things that are very important for the large-scale reactor. You cannot find them out on too small a machine. It turned out to be about 50 megawatts. Our calculations came out near 50, or it was set at 50.

Chairman DURHAM. Mr. Price, do you have any questions?

Representative PRICE. Unfortunately, Mr. Chairman, I had to attend a very important meeting on the National Guard problem before the House Armed Services Committee so I did not have an opportunity to hear either Dr. Zinn or Mr. Sporn.

I will read their testimony at a later date and study it very carefully.

I did see one item in the estimate cost, the $3 million item, postoperational research and development. I would like to have a little elaboration on that and what items are anticipated in that fund.

Dr. ZINN. I would be glad to try to elaborate on that. This is a prototype reactor. In order to find out what its performance really can be, you have to do some experimenting with it. That does not mean changing its basic structure. What it means is that you must have the ability of using certain channels in the reactor for tests of new types of fuel.

Probably the best way you can use research and development money, having built a reactor, is to see to it that you vigorously try to improve the fuel elements you have put in. For instance, in this reactor we can imagine really about three kinds of fuel elements to start with. To test these in the various ways in which they can be made is a real development job, and this postoperational research and development money is in there to make sure that such a program goes forward.

Mr. SPORN. I might add, Mr. Price, that actual amount we contemplate spending is $5 million, and if you look at the tabulation you will see that of the $5 million that is proposed the Atomic Energy Commission will spend $3 and the east-central nuclear group will contribute $2 million to the same program.

Representative PRICE. I notice that under the east-central group, but what about the Florida group?

Mr. SPORN. If you look at the bottom, the Florida group will be running the reactor and Florida will be contributing something over a million dollars in annual operating losses. So therefore, in setting up this partnership deal with Florida, it was decided that they should be free from any obligation to put in anything additional and the east-central nuclear group decided to work it out on the basis indicated here.

Representative PRICE. That is all, Mr. Chairman.

Chairman DURHAM. Thank you very much.

Thank you, Dr. Zinn and gentlemen, we appreciate very much your coming here before the committee.

Chairman DURHAM. The next witness is Mr. James B. Carey, president of the IUEW.

Mr. SIGAL. Mr. Chairman, my name is Mr. Sigal. I am testifying here in place of Mr. Carey. Mr. Carey regrets that he is unable to be here. At the time Mr. Carey was invited, the committee was informed of this possibility. I will give the statement for Mr. Carey.

Chairman DURHAM. Thank you very much. You may proceed with your statement.

STATEMENT OF BENJAMIN C. SIGAL, GENERAL COUNSEL, INTERNATIONAL UNION OF ELECTRICAL, RADIO, AND MACHINE WORKERS, AFL–CIO

Mr. SIGAL. Mr. Chairman, members of the committee, I request that this entire statement be put in the record. I do not intend to read all of it.

Chairman DURHAM. You may proceed as you care to.

Mr. SIGAL. Mr. James B. Carey, president of the International Union of Electrical, Radio, and Machine Workers, AFL–CIO, has requested that I extend his regrets that he cannot appear before you today. I am testifying on behalf of IUE. We greatly appreciate this opportunity to appear before you to present our views on some of the aspects of the "development, growth, and state of the atomic energy industry."

The IUE–AFL–CIO has thousands of members employed directly in the application of the nuclear sciences. Additional thousands are engaged in the development, manufacture, and testing of the multitude of electronic devices upon which so much of this science depends. But our interest goes beyond those who may earn their livelihood, directly or indirectly, from this industry. There are several hundred thousand other members of IUE who, like all other people in this country, will be deeply affected by the progress, or lack of progress, in this field.

We have been appearing before this committee year after year in the hope that our voice would be heard, and to help make it possible for this country to—

> devote its entire heart and mind to find the way by which the miraculous inventiveness of man shall not be dedicated to his death, but consecrated to his life.

Perhaps no more fitting introduction to my remarks may be made than a reference to some eloquent statements on this subject recently made in the Senate. For example, on February 4, 1958, Senator Monroney, declared, in part:

> * * * So I believe that the other side of the shield of atomic power and nuclear energy is going to be what my friends, the former chairman and former vice chairman of the Joint Committee on Atomic Energy, the Senator from New Mexico (Mr. Anderson) and the Senator from Tennessee (Mr. Gore), and others have tried to make it be. What they have attempted to do has been to beat the atom into a plowshare. Their imaginative approach has been toward using the byproducts of atomic energy to cure diseases, to permit the raising of better agricultural crops, to improve transportation, and, above all, to make pure water for irrigation purposes out of sea water—all that to be done by means of the use of atomic reactors. This approach, if we but devote to it our minds and our money—money measured almost in terms of pennies, as compared to the thousands dollar bills we are spending for instruments of death—will win the hearts and minds of peoples around the world * * * (Congressional Record, 1383).

During the course of the present hearings, Mr. Chairman, you have heard statements from unexpected sources confirming what some of us have said for years. In 1953, this committee held extensive public hearings on the—

> problems involved in determining national policy toward the development of atomic energy for power purposes without harming in any way the national security of the United States.

At that time the United States undoubtedly led the world in the atomic sciences, and the national security was dependent in part at least on the leadership we had in the military application of nuclear science. In the 5 years that have elapsed, the leadership which we held, both in the peaceful application of nuclear sciences and in their military application, are now being seriously challenged by others.

We then said that the proposed amendments to the Atomic Energy Act, insofar as they related to the use of atomic energy for electric power, were premature. We urged that private industry was not yet ready to take on the burden.

The fundamental error of the proponents of the 1954 amendments was well stated in the final report of the Twelfth American Assembly, held at Arden House, Harriman, N. Y. The report said, in part:

> In recommendations which were taken into account in the drafting of the Atomic Energy Act of 1954, it was hoped that private industry could assume a more substantial role in the development of atomic power reactors. In the light of what has been learned since that time about the technical complexity and the cost of the program and the greater need for international actions, it is now apparent that at this time there is a larger need for Government support and leadership.

I request that the full statement be placed in the record following my remarks. I have a copy of the report of the Twelfth American Assembly, Mr. Chairman.

Chairman DURHAM. Without objection, it will be placed in the record.

Mr. SIGAL. In 1953, on page 489 of the hearings, I urged upon this committee the position that—

> the burden is upon those who would amend the act to demonstrate that their proposals would achieve these objectives more effectively than the present law would permit.

I pointed out then, page 493—

> that a full-scale atomic power plant would cost no less than $75 million and closer to $100 million.

It was clear then as it is today, that—

> no industrial group has indicated that it is prepared to provide sums of this magnitude.

Those who would contend that we must now subsidize private enterprise into ownership of the atomic power industry have a heavy burden to show that the dead-end street into which the present leadership of AEC has led this country will not remain closed under this policy, and that the United States will not be condemned to being a second rater in this field.

On January 16 1958, Senator Gore pointed out that the Congress, under the leadership of this committee, sought to pass a bill in 1956 which would have directed that—

> the resources of this Nation be marshaled to bringing into being processes for the economic generation of atomic power in commercial and industrial quarters.

Such marshaling of our resources was promised to the world, in effect by President Eisenhower in his great atoms-for-peace speech to the United Nations General Assembly on December 8, 1953. That promise has not been fulfilled. The resources we have applied have been, relatively speaking, disappointingly meager. The world has been disillusioned.

The bill referred to by Senator Gore was passed by the Senate, but was defeated in the House. The need for that program increases daily. The seriousness of the situation is now recognized even by those who made the unconditional statement in 1953, along with Walker Cisler, that—

Traditionally competitive free enterprise is ready and able to undertake the task.

But now, 4 years older, and with more experience if not wisdom, the industry leaders have changed their refrain. A recent survey of the atomic energy industry reveals that a majority of the leaders want the Government to subsidize the private atomic power reactor industry, including subsidies of capital costs (Nucleonics, February 1958, pp. 17–20).

Thus, the leaders of the industry have finally admitted publicly that competitive free enterprise is not equal to the task of vigorously developing economic atomic power reactors with private funds. Much valuable time has been lost while we paid costly homage to those who prophesied the doom of the free enterprise system if we did not immediately turn this work over to private industry.

Yet, despite this admission of failure, and despite the general recognition among industry leaders that national policy considerations require rapid development of economic atomic power reactors, private industry continues to demand that it be permitted, in effect, to control future development of the art. That is what the demand for subsidies means. These leaders of the free competitive enterprise system want to repeal, or at least radically amend, the universal law that one has to pay the piper if he wants the privilege of calling the tune.

This result follows from the way AEC carries out its program in this field. It cannot direct an applicant for a license to build a particular kind of a reactor at a particular site. It must either approve or disapprove the type of reactor and the site selected by the applicant. So long as AEC persists in its refusal to build full scale development reactors itself, for example, we must drift along rudderless in this largely uncharted sea, waiting hopefully for the mariner who wants to go in the right direction. Meanwhile, to change the figure of speech, the "courageous" entrepreneur who wants to build a reactor according to his own heart's desire will be entitled to a generous share of public funds. Thus, private industry will go only as fast as it sees fit, in the direction it sees fit, well protected by the taxpayer against any serious risk.

We submit that, in the light of the sorry record it has made, the current demand of private industry for subsidies in the atomic power field is colossal effrontery.

We agree that much more money must be spent for development purposes than has been spent and that a much more vigorous program must be launched. But since it is now clear that this cannot be done except with a large increase in the expenditure of public funds, then the Federal Government must control and direct the program.

I shall not, at this time, restate at any further length the argument against subsidies for this industry. They have been oft-repeated and are well known to this committee. However, I should like to direct your attention to the question of safety in connection with this problem. As you are of course aware, when an applicant seeks a construction

permit for a particular site, the decision as to whether to grant the permit is made with reference to that site. However, no matter how many unsolved problems there may be with reference to safety, once the permit is granted, nothing more can be done about the site, regardless of its proximity to population centers. AEC does not presume to suggest that another site would be preferable.

This method of operation ought not to be permitted to continue so long as atomic power reactors are in the experimental stage.

Dr. Abel Wolman presented this problem to this committee when he appeared before you on February 20, 1958. Lest it get less attention than it deserves, I should like to quote part of his testimony here. You had before you on that day, in addition to Dr. Wolman, Dr. Rogers McCullough, Chairman of the Advisory Committee on Reactor Safeguards. In the course of Mr. Holifield's questioning about the functioning of that committee, the following colloquy occurred:

Representative HOLIFIELD. Is it possible, in the case of a reactor such as the PRDC, for them to build certain parts of the reactor—I am not thinking about the building or foundations or the roof, but the reactor itself—when there is still a large area which is still in the realm of the unknown.

Mr. MCCULLOUGH. There are two ways of approaching this. They could hold up on certain of the controversial—I am speaking technically now and unknown features is a better word—and the other thing they could do, if in their technical judgment they feel it is worth while, they can construct that, realizing they may have to redo it. It is their money and I guess they can make that choice.

Mr. WOLMAN. I would like to add another alternative, if I may, Mr. Chairman, and that is the alternative of deferring the construction at a particular location, which is part of the evaluation which the committee should make and does make of the series of alternate choice that you refer to.

There are a series of scientific and technological alternatives. There is the question of containment, and there is, lastly, the question of site. * * *

I am not certain at all that all of us have resolved those value judgments in relation to distance and population. I am sure that Dr. McCullough would say to you for the committee that there are very serious questions that arise with respect to newer ones and more numerous ones that will grow in our country, as to whether the site selection does not become the key answer as the art and science advance.

I for one place the site selection, perhaps because of past experience in my own professional function, as the No. 1 consideration. That has to be balanced against the desire of everyone in our country to move this art forward as rapidly as possible.

We, too, consider site selection of experimental reactors the No. 1 consideration. So long, however, as the private applicant picks the site, it will be a secondary consideration. Considerations of the applicant's own convenience, from the point of view of proximity to his customers, will get primary emphasis. Consequently, if the public purse must bear an increased share of the cost of developmental reactors, as it must, then AEC must control site selection for such reactors.

In conclusion, Mr. Chairman, we urge the committee and the Congress, to reject the demand for direct or indirect subsidies. The program which, in our opinion, will carry out the policy urgently needed at this time is incorporated in the Gore bill, S. 3000, and we vigorously urge its adoption without delay.

(The report of the 12th American Assembly follows:)

FINAL REPORT OF THE 12TH AMERICAN ASSEMBLY HELD AT ARDEN HOUSE, HARRIMAN, N. Y., OCTOBER 17–20, 1957, ON ATOMS FOR POWER: UNITED STATES POLICY IN ATOMIC ENERGY DEVELOPMENT

At the close of their discussions the participants in the 12th American Assembly reviewed as a group the following statement. Although there was general agreement on the final report, it is not the practice of the American Assembly for participants to affix their signatures; and it should not be assumed that every participant necessarily subscribes to every recommendation included in the statement.

PREAMBLE

The United States has attained a worldwide reputation for preeminence in science and technology. Whether we like it or not, the maintenance of the United States position in the image already fashioned is a factor in the present world struggle. In such a situation the position of the United States is inescapably competitive.

The United States policy in atomic-power development must, for this and other reasons, be appraised not only in domestic but also in international terms. Conclusions reached by weighing our existing national fuel resources and needs and present costs of power produced by nuclear reactors may need to be modified by foreign policy considerations.

The importance for society of the development of peaceful uses of atomic energy is widely felt but inadequately understood. Not surprisingly, so far as the near future is concerned, the immediate and universal use of atomic power has been oversold. Ultimate possibilities both in the United States and more especially in the world at large have been mistaken for present realities. Disappointments are inevitable.

This situation already has had consequences of national and international importance. The national consequences, in terms of dissatisfaction with governmental actions and policies, may not in the long run prove to be significantly damaging. They may not, for example, materially affect the ultimate progress of scientific research or of applied technology in the United States. On the international plane, in the present position of the United States as a world power involved in the constant competition of cold war, disappointments may have harmful results which, while perhaps unjustified, are none the less real.

Nor is it possible to divorce considerations of United States atomic power policies from problems of national defense and accumulation of atomic weapons in the arsenals of this and of other countries. The dispersion of atomic-power reactors throughout the world is inevitable. The consequence will be that many States will have available atomic weapons material. The dangers of diversions to weapons use will then be multiplied unless in the meantime adequate international safeguards are devised and effectively employed.

It is imperative that comprehensive and continuing study be devoted to the present and future impacts of the atomic age. Such study may range from the beneficial uses of radioisotopes to the ultimate tragedy of thermonuclear war. The whole subject is far too vast for consideration by any one group in any single conference. This report relates to one particular problem: The utilization of atomic energy for the production of power. Its focus is upon the United States and the policies which the United States should adopt.

FINDINGS AND RECOMMENDATIONS

Power resources and needs in the United States

Although there are some regions such as New England, Florida, and parts of the west coast which, in United States terms, are relatively high-cost fuel areas, the United States, unlike many other countries, has today, and will have for some years to come, plentiful low-cost fuel supplies. The United States has therefore not been impelled by immediate need for a new source of fuel for power to press forward with the development of the production of atomic power on an urgent basis. Our atomic-energy program reflecting our felt needs, has progressed from weapons, to naval propulsion, to power. Considering only our national-power needs, present and projected, an extensive program of construction of large-scale power reactors in this country is not desirable.

The development of economic atomic power is slow because of the newness of the art, the longtime cycle from idea to operating reactors, the lack of experience with the operation of any type of atomic-power reactor over a sufficient period of time, and the numerous technological problems still unsolved. Moreover, the development and capital cost of atomic-power reactors is so high that the kilowatt-hour cost of power produced by such reactors cannot now compete on an economic basis in the United States with that of conventional powerplants. Again, consideration of the national power needs alone does not require concentration of available resources upon the perfection of atomic-power reactors.

Nevertheless long-range estimates of eventual energy demands in the United States together with appreciation of the potentialities of atomic power require the United States to proceed with research in and experimentation with what appear to be promising types of reactors as well as with a vigorous nuclear-research program. There should be concentration on technological development and the achievement of methods for bringing about economic nuclear power.

In the course of this technological development the general need for improved education and training is sharply emphasized. Advances in education and training in this particular field are necessary to the recruitment of adequate personnel. Attention should also be paid to securing a more adequate flow of information which can be achieved without danger to the national security.

The cost of the requisite technological development must be appropriately shared. In conventional power generally the power industry indirectly absorbs a share through the cost of purchased equipment; the manufacturing industries make direct expenditures on research and development. In the case of atomic power the conditions are different and the conventional pattern does not apply. The primary applications of atomic energy were to weapons and were entirely controlled and financed by Government. As attention was turned to a general atomic energy program, the MacMahon Act of 1946 still provided for a Government monopoly. This was no longer necessary or appropriate when attention was directed to the development of atomic power. This fact was recognized by the relaxations registered in the Atomic Energy Act of 1954, which had as its objective the acceleration of the development of commercial atomic power by authorizing a program of development by private industry to supplement an enlarged program to be conducted by the Government. Nevertheless, the problem of the appropriate distribution of effort and cost between Government and private enterprise has not yet been satisfactorily solved.

The distribution of functions—public versus private

It is impossible wholly to escape the impact of the controversy over the relative roles of public and private enterprise in regard to power. Opinions differ as to whether this controversy has hindered the development of atomic power, but there is no doubt that it is still an important political issue. Given the unique problems involved in the development of economic atomic power, it is clear that Government must continue to play a large role. In view of the time factor involved, private industry cannot alone absorb the cost of research, experimentation, and construction of atomic powerplants. Government financial support is necessary in the atomic power program. The necessary assistance may be supplied directly by Government or by Government-supported research and development and through the supply of nuclear fuels and other materials and services priced with avowed reference to the necessity for Government support. If such essential support would conflict with existing legislative restrictions on subsidies, the law should be amended. On the other hand a minority urges that subsidies in any significant amounts should not be provided but that the Government itself should construct atomic powerplants both large and small for demonstration purposes.

In the present pattern, there are four types of atomic-power projects in the United States. On the one hand are the completely Government-owned-and-operated facilities. On the other hand are facilities privately constructed, owned, and operated, but also subject to Government controls and purchasing from the Government their nuclear fuels. In between are two types of hybrids. In one type the Federal Government retains title to a facility to the cost of whose construction or operation—or both—others contribute. In the second type, private industry has title as licensee but receives assistance from the Government.

The dependence of private industry upon Government assistance in atomic-power development is inescapable. In such a situation there will remain for a considerable time the problem of finding a formula for equitable distribution

of costs between the stockholder, the consumer, and the taxpayer. No conclusive solution of this problem has been found, but it would not be in the public interest to allow the atomic-energy program to be retarded by disagreements over this issue. The injection of the public-private dispute into the atomic field at this time is unnecessary and unfortunate. During the period of the next years when the best that can be expected is an economic demonstration project, public and private power agencies have a common, not a conflicting, interest in the program. A truce is possible on terms which will not prejudice the respective roles of private and public power groups and which will not inhibit either group in its stand on the broad principle of the proper roles of Government and industry in a democratic society. The necessary Government assistance should be available to both private and publicly owned power agencies without discrimination.

Accurate forecasts of the cost of nuclear power cannot be made until plants have been in operation for at least 4 or 5 years, since at present there is inadequate experience in the construction, operation, and life of reactors and their components including fuel. Proceeding on an experimental basis with prototypes which might range from 1- to 50,000-kilowatt capacity, the development of improved types of nuclear-power reactors can provide useful experience, thus avoiding the very large cost of constructing power-producing plants designed for maximum power production. Another view is that the necessary engineering and technological experience can be gained only through the actual operation of large-scale reactors.

Private industry has already ventured capital in the construction of a few such large plants and will continue to do so if more economic motivation than now exists is made available. At present this is not to be expected, particularly in the light of an anticipated early technological obsolescence of any plant which may now be constructed. Such construction therefore will be dependent upon Government financial support.

The international perspective

Decisions on the type and size and schedule of construction of reactors cannot be made solely with an eye to national-power needs in the United States and must be influenced by considerations of an international character.

When the United States atomic-power program is viewed in the perspective of the international situation and of our foreign policy, a variety of new elements are introduced into the picture. A final view cannot ignore their intimate interrelation.

The demand for the rapid development of atomic power is urgently felt in various foreign countries. In the United Kingdom the requirement for energy is far outstripping coal production. Anticipated increases in coal production through large investment of funds in modernization of the mines will fail to fill the gap; it can be filled only by other sources of energy—oil or atomic energy. Increased imports of oil constitute an unacceptable strain upon Britain's international balance of payments. Moreover, recent developments in the Middle East have brought home the dangers of too great a reliance upon oil from that area. The result has been the adoption of a policy of rapid construction of large-scale powerplants initially of the Calder Hall type which is in operation.

In Western Europe comparable needs for increased power resources have been exemplified by the creation of Euratom, which is expected to begin functioning by the first of the year and to encourage the construction of atomic powerplants as rapidly as possible. In the Soviet Union there is an active reactor development and construction program. Among the other heavily industrialized countries, similar steps are planned in Japan. Even in the less industrialized areas, for example, in Latin America and in the underdeveloped countries of Asia as well as in the Middle East, atomic studies are underway.

The industrialized countries

The great international significance attached to President Eisenhower's atoms-for-peace speech to the United Nations in December 1953 gave the United States a moral and psychological lead. It paved the way for the Geneva Conference and opened up new areas for international cooperation. The United States, taking into account the present attitudes of prospective purchasers, should move with vigor to take full advantage of that lead in countries which are prepared to proceed, or which insist upon proceeding forthwith to the installation and operation of atomic powerplants. From the standpoint of meeting the challenge and the opportunity created by these rising foreign demands, the United States cannot be complacent.

In the United Kingdom a national power need did contribute the vitality and sense of direction necessary to the active implementation of an atomic power program. The new vital thrust which the creation of Euratom may well supply can afford that direction and impetus to a United States atomic-power program which has hitherto been lacking because national-power needs did not afford a motivation for supplying them.

Euratom's target has been set in the planning stage at 15 million kilowatts of atomic power within a decade, and more to follow. Experience and progress in the next few years will probably determine whether this goal can be reached. They recognize a need for a rapid beginning toward a kilowatt schedule and for concentrated engineering experience to provide a future. Euratom may therefore be taken as a symbol of potential foreign markets, whether they open up in the immediate or in the more distant future.

In getting started, Euratom may turn in part to tested reactor designs, such as the improved Calder Hall reactor. It is also looking to America with the belief that American participation could be a critical factor in launching and developing its program. The diversified program in the United States is a promising basis for extensive participation and support. The participation of American capital, enterprise and technological skills in European developments should be encouraged along the lines of existing joint ventures.

A major effort on the part of American industry and Government would provide the American atomic-power program with vitality and purpose and accelerate the development of power at home. While it can be expected that highly industrialized countries such as those in Europe will ultimately establish their own facilities for building their atomic powerplants, Euratom can provide American industry with experience as well as a market for its products and technology. Such an effort would assist the aims of American foreign policy in developing the economic strength of, and American ties with, the western European community, and would assist in the establishment of an integrated Western Europe. It would provide experience in the operation of large-scale reactors of great and immediate benefit to our own development program.

The implementing of such an effort will raise many questions of governmental organization and machinery to facilitate and support the undertaking and may well require legislation. It will heighten the importance of removing obstacles to industrial participation abroad. What is more important at the moment, however, is the establishment and declaration of purpose. There is considerable urgence for action now, if the opportunity for such participation is to be seized.

There is an additional line of action which would serve United States foreign policy objectives and also contribute to the development program in the United States; the proposal suggested above would exploit principally the present technology. This second line of action, not inconsistent with the proposal just described, is for the United States Government and industry to proceed vigorously in developing prototypes for reactor types most suited to paving the way for large-scale reactors to be built in other countries to fullfill economically the more immediate power needs abroad. This approach should not exclude a modest further cooperative Government-industry program to build large-scale demonstration reactors in the United States.

The less industrialized countries

Insofar as the less-industrialized countries are concerned, it is necessary to distinguish between those which have progressed to various stages of industrialization and those which still must start from scratch. While power is an indispensable element in an industrial economy, it is only one element and not the most important in the complex. Its development and use must be timed in relation to the development of the need for power as well as the requisite training and skills in the utilization of power facilities. In some countries, primary emphasis should be laid on nonpower uses of atomic energy. While the United States may suggest these considerations to the governments concerned, we should recognize that the final appraisal must be their own.

The International Atomic Energy Agency

The United States wisely took an initiative that led to the establishment of the International Atomic Energy Agency. The Agency has an important role to play in fostering cooperation on a worldwide basis and in assisting the atomic development of less industrialized nations. Avoiding excessive preoccupation with organizational detail, the United States should take an active part in achieving these objectives and in advancing the Agency's important func-

tions with respect to international controls and safeguards. The relationships between the Agency's program and the bilateral programs that the United States has developed should now be reviewed.

The need for Federal leadership

There is urgent need for a thorough review of the United States atomic power program. Such a review should lead to a clear formulation of the program's objectives in terms of the national-power needs of the United States in the long run as well as the immediate requirements of United States foreign policy. Prior policies were adopted in the light of considerations thought valid at the time of their adoption. The relevant factors have changed; policies and programs must be changed to meet them. Since various interests in the United States, including industry and labor, must participate in the implementation of the program, the objectives must be clearly stated and widely publicized in order that they may be widely understood, not only by those directly interested but by the public at large.

In recommendations which were taken into account in the drafting of the Atomic Energy Act of 1954, it was hoped that private industry could assume a more substantial role in the development of atomic-power reactors. In the light of what has been learned since that time about the technical complexity and the cost of the program and the greater need for international actions, it is now apparent that at this time there is a larger need for Government support and leadership. The desired rate of progress calls for the AEC to assume more positive leadership and direction. In the light of newly defined objectives, the Commission should promptly prepare and disseminate a more carefully coordinated and scheduled program for both governmental and nongovernmental activity. It should provide the financial support needed to make possible such private as well as governmental activity. To this end, the AEC should take steps to strengthen its internal administration of the program, with primary emphasis on positive accomplishment of its objectives in the power field.

Opinions differ on the most desirable means by which the Commission should achieve these results. One line of thought favors the establishment of a broadly constituted advisory group to help in the framing of the program. The necessity of securing the cooperation of the joint congressional committee is obvious. It is thought by some that implementation of the program, when formulated, can best be secured through Presidential action based on the advice of the National Security Council.

There is unanimous agreement on the point that the policy and program when adopted should be supported at the highest Government level.

LIST OF PARTICIPANTS—TWELFTH AMERICAN ASSEMBLY

Altschul, Frank, New York.
Bacher, Robert F., chairman, division of physics, mathematics, and astronomy, California Institute of Technology.
Ball, George W., Washington, D. C.
Bauman, Mrs. John Sprague, chairman, committee on peaceful uses of atomic energy, National Council of Women, New York.
Benoit, Emile, associate professor of international business, Columbia University.
Block, Paul, Jr., publisher, Toledo Blade, Ohio.
Brown, George R., Brown & Root, Inc., Houston.
Cavers, David F., professor of law and associate dean, Harvard University Law School.
Collings, L. V., chairman of the board, Standard-Vacuum Oil Co., White Plains, N. Y.
Colm, Gerhard, National Planning Association, Washington, D. C.
Cowles, John, president, Minneapolis Star and Tribune, Minnesota.
Creamer, Thomas, vice president, First National City Bank, New York.
Crow, Allen B., president, the Economic Club of Detroit, Mich.
Cunningham, Ross, associate editor, the Times, Seattle.
Dean, Gordon E., Lehman Bros., New York.
DuBridge, Lee A., president, California Institute of Technology.
Ellinger, Merlin E., Jr., Harriman Scholar, Columbia University.
Gadsby, George M., chairman of the board, Utah Power & Light Co., Salt Lake City.
Goodman, Leo, atomic energy advisor, United Auto Workers of America, Washington, D. C.

Haworth, Leland J., director, Brookhaven National Laboratory, Long Island.
Henkin, Louis, School of Law, University of Pennsylvania.
Hobby, Mrs. Oveta Culp, Houston.
Hollis, Everett L., General Electric Co., New York.
Iddles, Alfred, chairman of the board, Babcock & Wilcox, New York.
Kernochan, John, director, legislative drafting research fund, Columbia University.
Kitts, Vice Adm. W. A. III, manager, atomic production study, General Electric Co., Schenectady.
Kline, Allan B., former president, American Farm Bureau Federation, Western Springs, Ill.
Knorr, Klaus, Center of International Studies, Princeton University.
Laurence, William L., science editor, New York Times.
Lemnitzer, Gen. Lyman L., Vice Chief of the General Staff, United States Army.
Luntz, Jerome D., editor, Nucleonics, McGraw-Hill Publishing Co., New York.
Lyman, A. L., president, California Research Corp., San Francisco.
Marks, Herbert S., Marks & Trowbridge, Washington, D. C.
Menke, John R., president, Nuclear Development Corporation of America, White Plains, N. Y.
Mullenbach, Philip, the Twentieth Century Fund, Washington, D. C.
Murphy, Arthur W., Hughes, Hubbard, Blair & Reed, New York.
Netschert, Bruce, Resources for the Future, Inc., Washington, D. C.
Nichols, Calvin, executive director, World Affairs Council of Northern California, San Francisco.
Old, Bruce S., vice president, Arthur D. Little, Inc., Cambridge, Mass.
Oppenheimer, Robert, director, Institute for Advanced Study, Princeton.
Palfrey, John, professor of law, Columbia University.
Parcell, Raymond E., Jr., Harriman scholar, Columbia University.
Penneis, Stuart A., Harriman scholar, Columbia University.
Peterson, William S., general manager-chief engineer, Department of Water & Power, Los Angeles.
Pike, Sumner, State coordinator, atomic energy development, Lubec, Maine.
Pollard, Rev. William G., executive director, Oak Ridge Institute of Nuclear Studies, Tenn.
Price, Don K., vice president, Ford Foundation.
Pulliam, Eugene C., Jr., managing editor, Indianapolis News, Indiana.
Rabi, I. I., Higgins professor of physics, Columbia University.
Sigal, Benjamin C., IUE–AFL–CIO, Washington, D. C.
Slick, Tom, San Antonio, Tex.
Smyth, Henry D., chairman, board of scientific and engineering research, Princeton University.
Sporn, Philip, president, American Gas & Electric Co., New York.
Stason, E. Blythe, dean, School of Law, University of Michigan.
Stein, Eric, professor of law, University of Michigan.
Swift, Adrian, A. W. Swift & Co., Keystone, Okla.
Vance, Harold S., United States Atomic Energy Commission, Washington, D. C.
Ward, J. Carlton, Jr., president, Vitro Corporation of America, New York.
Warren, Dr. Shields, Cancer Research Institute, New England Deaconess Hospital, Boston, Mass.
Weaver, Charles H., vice president, Westinghouse Electric Corp., Pittsburgh.
Whitman, Walter G., Department of chemical engineering, Massachusetts Institute of Technology.
Whitmore, Charles H., president, Iowa-Illinois Gas & Electric Co., Davenport, Iowa.
Wilson, Carroll L., president, Metals & Controls Corp., Attleboro, Mass.
Yates, J. P., senior vice president, Bechtel Corp., San Francisco.

Chairman DURHAM. Thank you very much for your statement.

Mr. Price, do you have any questions?

Representative PRICE. I have no questions at this time, Mr. Chairman.

Chairman DURHAM. Mr. Sigal, I believe that under the present procedure of the law with respect to site selection, the Committee does have the authority to take this into consideration as to safety. They have turned down one, as you know, probably, in the city of Piqua.

Mr. SIGAL. I did not mean to imply that the Committee may not advise against a particular application where it finds that the site is not an appropriate one, and the Commission may turn it down. What I am saying, as Dr. Wolman pointed out in his testimony, is that the Commission and the Committee may be completely boxed by the nature of the application. They may feel, for example, that there are serious doubts as to the question of site, but nevertheless, taking all things into consideration, and since there is no alternative site proposed by the applicant, they are willing to go ahead and give a construction permit in the hope that in the course of construction the various safety problems will be solved satisfactorily, and, therefore, of course, the site will be a proper one for the given reactor. That is exactly the problem that now exists with respect to the application of the Power Reactor Development Co. which is pending before the Commission.

The intervenors, whom I represent in that case, challenged the site as well as the reactor itself from the safety point of view. It appeared in the testimony of the applicant that they are confident that they will be able to solve the safety problems, at least to such an extent that even though there may be doubts as to the use of the site selected, doubts which were very eloquently set forth by Dr. Wolman in that case, the site question will disappear.

Chairman DURHAM. Do you feel that this Safety Committee should have final authority on the site?

Mr. SIGAL. If you are referring to the ACRS, that Committee is only advisory.

Chairman DURHAM. I understand that the Commission has the authority and power to overrule them.

Mr. SIGAL. Yes.

Chairman DURHAM. Do you feel it would be safer to have it in a committee that is set up to evaluate safety hazards, that they should have the final authority on site selection?

Mr. SIGAL. When you have a private applicant submitting his application on the basis of a given site, the Committee is without power to suggest something else. They do not have alternative sites from which to choose. The applicant does not suggest alternative sites. He comes in and suggests one site, and the application must be approved or disapproved on the basis of that site along with a particular kind of reactor that is proposed for that site.

Again referring to the PRDC case, the Advisory Committee in that case in making its report made no reference whatever to the site. It simply said that in relation to this site they had certain recommendations to make with regard to the reactor itself. But they said nothing about the site. It was not until we came to the hearing, and a member of that Committee testified, that all the doubts with respect to that site were put on the public record.

Chairman DURHAM. You are talking about the safety committee?

Mr. SIGAL. Yes. That is a real problem, it seems to me, and it is not adequately met by the procedures now used with reference to action on applications by private industry. When the AEC itself builds reactors, or has built them, it has always had a number of alternative sites before it for consideration for particular kinds of reactors.

The Advisory Committee has, on more than one occasion, said to AEC—

> The site that you have selected for this particular kind of reactor we think is not the best. We suggest you use another site.

But the Advisory Committee does not have those choices when a private applicant comes before it and does not give it the choice, because it has proposed only one site in its application.

Chairman DURHAM. Thank you very much, Mr. Sigal.

The next witness is Mr. William A. Steiger, vice chairman of the committee on patents, National Association of Manufacturers.

STATEMENT OF WILLIAM A. STEIGER, VICE CHAIRMAN, THE COMMITTEE ON PATENTS OF THE NATIONAL ASSOCIATION OF MANUFACTURERS

Mr. STEIGER. Thank you, Mr. Chairman.

Mr. Chairman and members of the committee, my name is William A. Steiger. I am vice chairman of the committee on patents of the National Association of Manufacturers, chairman of that committee's subcommittee on atomic energy, and I am speaking today for that association. The National Association of Manufacturers consists of 22,000 members representing a cross section of all sizes and types of business organizations. The patents committee of the National Association of Manufacturers has been recognized for many years as an active and leading group in its field.

It is generally recognized that the United States patent system has beena major factor in creating the high standard of living which prevails in this country. When the 1954 Atomic Energy Act was passed, it was the intention of the Congress to stimulate and encourage scientific and industrial progress, as well as wider participation in the development and utilization of atomic energy for peaceful purposes. However, as the law was enacted, normal patent incentives were, in the main, eliminated. It is our understanding that your committee recognized the weakness of the patent provisions at the time of passage, and that it was the intent of Congress to remedy this situation during its next session. However, in the 3½ years this act has been in effect, no amendments relating to the patent provisions have been made and, consequently, proper stimulation and encouragement to American inventors are lacking.

If this country of ours is to be represented in world affairs by a patent position consistent with its inventive contributions, we urge that the patent provisions of the act and the Commission's patent policy on Government contracts be revised as soon as possible. More specifically, in order to gain a lead in the international scientific race, as well as propagandizing our inventive incentives under the American system, we must reevaluate the situation.

There are many indications that, so far as private enterprise is concerned, the program needs stimulation. We know that your committee is interested in encouraging the investment of private risk capital in research and engineering efforts in this field. However, industry has found that work in this field requires an unusually large investment in research and engineering effort. Traditionally, industry has relied upon patents to protect such an investment but, as

long as the 1954 act remains as is, the private concern is not encouraged to invest its time and money in the atomic field. If it invests in the atomic field and obtains patents protecting its development, it has no way of knowing whether such patents are valid. In other words, Section 155: Prior Art of the 1954 act is a radical departure from our established patent system and creates a hopeless condition as to the evaluation of any patent issued in this art. Moreover, there is the threat of compulsory licensing which hangs over any patent as a potential devaluation factor. Therefore, while the 1954 act was passed with the expectation that it would stimulate investment of private risk capital, this and other patent provisions are inconsistent with those worthy objectives.

As a consequence, most research and development being presently carried on in this field is supported partly or entirely with Government funds. While this country has been the world leader in research, development, and money invested, it has, sad to relate, a poor patent position. Again, this results from the provisions of the act, and particularly Section 152: Inventions Conceived During Commission Contracts.

Under this provision, all inventions made or conceived under any contract, subcontract arrangement, or other relationship with the Commission shall be deemed to have been made by the Commission. Consequently, thousands of invention disclosures sent by Government contractors to the Commission go "down the drain." The Commission is in no position to apply for patents or develop these ideas except in a few cases. On the other hand, there is no incentive for the contractor to spend time and money developing these ideas, because he has no assurance of patent protection for his investment.

In most cases, the Government does not want a patent but, at the same time, the contractor cannot have it. In those few cases where the Government obtains a United States patent, such patent really represents an empty gesture, because we have the spectacle of our Government granting to itself an exclusive right which it really has no use for. These patents serve only as publications; they are not useful in their intended way to protect investment in research and development, nor are they useful to protect the investment of public funds in this type of work. This situation, going on year after year, can only have one result; namely, the future patent position in atomic energy will reside primarily with foreign nationals, who secure patent protection in this country with relative ease while inventors here are largely obliged to forgo their just rights.

There is a provision in section 152 of the act which gives the Commission the right to waive its claims to any invention or discovery made under or in connection with a Government contract. However, the waiver provision has been used very sparingly, as one would expect. We find no fault with the administration of the Commission because, in view of the law and the possible thinking of your committee, an employee of the Commission would appear to be justified in his extreme conservatism. An issued patent establishes, for all the world to see, the name or names of the individuals making that particular contribution. In the years to come, the history of the development of atomic energy for peaceful purposes will be predicated on the record, on patent history to a large extent. We, there-

fore, recommend that two things be done; namely, (1) remove from the 1954 act the limitations on the patenting of inventions in this field, and (2) change the present patent policies with respect to the Government-supported contracts.

The patent provisions of Government contracts should be altered to provide greater encouragement and stimulation to Government contractors. With such changes, this country can develop a patent position consistent with its contributions. This can be done by permitting the contractor to file and obtain patents at his own expense covering inventions made by him in the course of the work. Title to such patents should reside in the contractor subject to a free, nonexclusive license to the Government to make, or have made for it, apparatus covered by such patents. These are all the rights that the Government requires as they insure the Government complete freedom of use. In this way, inventions of value will not "go down the drain" and development of many of these ideas with private risk capital will be encouraged. Such a policy would be consistent with the purposes of the act.

It has been said that our Government requires ownership of patents in order to negotiate with foreign governments. However, it would appear that the many inventions made by Government employees in Government laboratories should provide the Commission with adequate values on which to build a United States Government negotiating position. Our extensive Government developments should more than match the contributions of foreign countries.

Under section 152 of the act, the Commission has the right to take the Government contractor's foreign-patent rights as well as the domestic. Consequently, United States manufacturers are unable to develop a foreign-patent situation of value such as would aid him in selling abroad or which might aid him in offsetting the patent rights of foreign nationals.

While foreign governments and foreign nationals are working feverishly to establish strong patent positions, the United States is permitting its foreign-patent position to go largely by default. A search made by a member of NAM from October 1956 to October 1957 in Belgium showed 123 patents granted during that period in the atomic-energy field. Of these 123 patents, 5 were assigned to United States corporations and 10 to the United States Atomic Energy Commission. The British United Kingdom Atomic Energy Authority has four times that many. The remaining 108 were obtained by foreign companies or foreign governments. The American manufacturer endeavoring to do business in foreign countries is faced not only with the patents competition of foreign companies but by foreign governments as well.

The treaties or arrangements which our country has made with foreign governments are of little assistance to the United States manufacturer who is endeavoring to do business abroad on a private-enterprise basis. Government contractors should, therefore, be encouraged to obtain foreign patents at their own expense. Title to such patents would reside in the contractor, subject again to a free, nonexclusive license to the United States Government such as mentioned heretofore.

We urge, therefore, that Government contracts be so written as to encourage contractors to develop patent situations at their own

expense in foreign countries. Such a comprehensive foreign-patent situation would comprise a most effective means for demonstrating the technical contributions of the United States to the world. Further, it would facilitate sales of apparatus by American manufacturers abroad and the licensing of foreign manufacturers. It would add encouragement to United States investments abroad.

When the patent provisions of the 1954 act were drawn, the conditions obtaining were quite different from those of today. At that time, it was feared that a few companies who had been on the inside of this development might monopolize this business. Today, manufacturers are not fearful of such a situation, particularly in view of antitrust implications. It was also felt that a few of these insiders might obtain a patent situation dominating the entire industry; hence, compulsory licensing. As the fundamentals of atomic energy are well known, the inventions that are being made are necessarily confined to improvements. When a manufacturer is prevented from copying a patented device, he is compelled to do original development work to avoid the patent. This process of designing around the patents of others gives the public a choice of a number of different designs, and frequently results in many improvements being made over the first device on the market. Hence, the compulsory-licensing provisions, which are contrary to our traditional patent laws, are also contrary to the intent and purposes of the act.

It is, therefore, the recommendation of the National Association of Manufacturers that the Atomic Energy Act of 1954 be revised so as to place investors and Government contractors in this field in the same position, patentwise, as in any other field. Only by providing such stimulation will the United States maintain world leadership. To this end, we recommend that:

1. All reference to patents be deleted from the Atomic Energy Act of 1954 except those provisions relating to weapons, secrecy, or compensation, so that, in the nonweapon field, there will be a uniform patent law applicable to all inventions.

2. The contracting procedure of the Commission be revised to afford the contractor ownership of United States and foreign patents covering inventions and discoveries arising out of or resulting from Government contracts, such ownership to be subject to a free, nonexclusive license to the United States Government to make or have made for governmental purposes.

Chairman DURHAM. Thank you very much, Mr. Steiger. I am sorry that the gentleman who is handling the subcommittee on this part of the act had to be away from the city this afternoon, because I am sure he had some questions that he wanted to ask you on this very matter. The provision in the act expires in 1959 with regard to this matter of patents and compulsory cross-licensing?

Mr. STEIGER. Yes, sir; that is correct.

Chairman DURHAM. As you know, it has not been used, and there have been no applicants.

Mr. STEIGER. Yes.

Chairman DURHAM. I think we were told the other day that there has not been one under this provision.

Mr. STEIGER. I think the big problem, Mr. Chairman, if I may say so, the way we are going is just a shame, because this country has con-

tributed more to this art than any other country in the world. On the other hand, it has very little to show for it, patentwise.

They way it is operating is that, under this act and under this regulation of the Commission, the Government does not want the patent and they will not let the contractor have it. So, as a result, nobody gets a patent. The foreigners got the patent. These inventions are sent to the Commission. The Commission does not have the staff or money to patent them in this country or abroad, so they just go down the drain.

Naturally, the private manufacturer will not spend money to patent them, or he will not spend money in research and development unless he knows he is going to get something to protect his investment. It is becoming more and more apparent all the time that this country will have no patent position to speak of in this art. Unless this thing is changed, that will be the position this country will find itself in, and it is already late.

Representative PRICE. It may be that amendments to the patent provisions of the 1954 act will be required, but I certainly do not think we have arrived at the stage where we can throw the door wide open on the matter of patents. After all, the patent provisions were put in the act to protect all American industry and to prevent discrimination within the ranks of industry on important patents in a program where the major part of the financing has come from the Federal Government. I do not think it is as simple as you state in your presentation, Mr. Steiger. I think it is something that calls for reconsideration; yes, but I think the reconsideration should be based on whether or not we are giving full protection to all American industry and not just a few who may have had the privilege of participating in this program up to this point.

Mr. STEIGER. I would say, Mr. Price, from everything we can find in our association, the manufacturers are not worried about that. Every manufacturer feels he can take care of himself. It is not just the few. There are thousands in this business, as you realize. Perhaps not as prime contractors.

Representative PRICE. I agree with you, probably we should look over the patent section of this law, but I think we should have in mind, when we do, the protection of all American industry.

Mr. STEIGER. I think we agree with that.

Representative PRICE. That there should be no discrimination at all in this field of patents so that one group which has been in the program a long time might have a considerable advantage over others.

Mr. STEIGER. I think we agree with that.

Representative PRICE. I think the subject has been one that has worried this committee for some time. We have seen little effort, in our opinion, to do much with the present patent provisions. We agree with you there. There has been much laxity in that regard. I think it is high time we do reconsider the patent provisions of this law, either to tighten them up or do whatever is necessary to protect the art as far as we can possibly protect it with patent provisions, and to protect the rights and interests of all industry without any discrimination.

Chairman DURHAM. I can see your point, of course. The patent laws are too complicated for me, as an ordinary layman. One of your complaints is the fact that the foreign people who are in this business

are filing for patents and the AEC is not taking advantage of its authority to file for the American contractor, whoever he is.

Mr. STEIGER. That is right.

Representative PRICE. I think it is only natural that we would have an unusual situation, because this is an unusual program. It is a little different than the arrangement between the Defense Establishment and industry, because they deal with established concerns who had been in the aviation business before the Government itself was in the business. Here, the preponderance of information is coming from the Government to the industry. It is an unusual situation and, naturally, calls for unusual action. The situation is not quite analogous. We just do not have the same situations involved.

Mr. STEIGER. We hope something will be done.

Representative PRICE. We hope that it will, too.

Mr. STEIGER. It is going down the drain now.

Representative PRICE. It is something that will call for further attention of the committee.

Mr. STEIGER. It is not in the interest of the country, the manufacturers, or anybody, the way things are going.

Representative PRICE. We have been concerned about the matter of American ideas not being the ones that are patented in the overseas areas. We have been greatly concerned about that. It has caused a considerable amount of worry. In any correction we make, we want to be sure that there is not any favoritism shown toward those who have been fortunate to be in this program as against those who hoped they might be in but were never able to get in. We are thinking of all industry.

Mr. STEIGER. I think the same thing is happening in this country, too, Mr. Price, except that, in Belgium, the patents issue very quickly. So, it is easier to see the Belgium patent situation, whereas you know that it takes several years to have patents issue in this country.

Representative PRICE. That should not have been necessary. I do not think there is a basis for saying that the Commission did not have the finances to do it, because the Commission could have gotten the finances. I think it was a matter of lack of interest on their part.

Chairman DURHAM. It was their discretion, which they have not exercised.

Representative PRICE. They have not exercised the discretion they have within the provisions of the law. I think you have raised a good point on these patents. We have been a little bit disappointed at the discretionary powers which were not exercised to protect the American industry and the American Government in the filing of these patents overseas.

Mr. STEIGER. I think there is one problem I might call you gentlemen's attention to, and that is, usually, a patent attorney, when he files a patent application for an invention, discusses it closely with the inventor. I think as long as you have a situation where a man sits in Washington and tries to file a patent application for an inventor in Iowa, that he has never talked to, you have a difficult situation.

Representative PRICE. Whatever is done, I hope it is done for the protection of all industry and for the Government and for the taxpayers of the country.

That is all I have, Mr. Chairman.

Chairman DURHAM. Mr. Toll.

Mr. TOLL. The Chairman has asked me to state for the record that the Commission has informed the Joint Committee that it is making a survey of the patent-law provisions and AEC patent policies and that the Commission has scheduled public hearings on April 15 for persons to present views on the patent program, and, subsequently, the Commission would presumably make recommendations to the committee as to the patent program and that it would be appropriate for the committee to consider the subject at that time, perhaps.

Mr. STEIGER. I think the fundamental difficulty is with the law.

Chairman DURHAM. Thank you very much, Mr. Steiger, for bringing a very important matter to our attention.

Mr. STEIGER. Thank you, gentlemen.

Chairman DURHAM. The committee is adjourned until tomorrow morning at 10 o'clock in this room.

(Thereupon, at 4:10 p. m., Monday, March 3, 1958, the committee was recessed, to reconvene at 10 a. m., Tuesday, March 4, 1958.)

DEVELOPMENT, GROWTH, AND STATE OF ATOMIC ENERGY INDUSTRY

TUESDAY, MARCH 4, 1958

CONGRESS OF THE UNITED STATES,
JOINT COMMITTEE ON ATOMIC ENERGY,
Washington, D. C.

The joint committee met at 10 a. m., pursuant to recess, in room 1334, New House Office Building, Hon. Carl T. Durham (chairman of the committee) presiding.

Present: Representatives Durham, Holifield, Price, and Hosmer.

Present also: David R. Toll, staff counsel; and George E. Brown, Jr., and Richard Smith, staff members, Joint Committee on Atomic Energy.

Chairman DURHAM. The committee will come to order.

This is a continuation of the hearings under section 202 of the Atomic Energy Act of 1954, on the development, growth, and state of the atomic-energy industry.

Our first witness this morning is Mr. Francis K. McCune, vice president, General Electric Co., and general manager of its atomic-products division.

STATEMENT OF FRANCIS K. McCUNE, VICE PRESIDENT, GENERAL ELECTRIC CO.

Mr. McCUNE. Good morning, Mr. Chairman.

I have with me Mr. Kennedy, who is counsel for atomic-products division of General Electric Co.

Chairman DURHAM. We are glad to have him with us.

You may proceed, Mr. McCune.

Mr. McCUNE. I have a written statement which I intend to brief for you so that I will meet the 15-minute requirement on my oral testimony, if I may.

Chairman DURHAM. Well, you do not have to worry about the 15 minutes.

Mr. McCUNE. Would you like me to read it in full, or shall I go ahead and brief it?

Chairman DURHAM. You may read it in full. It is not too long.

Mr. McCUNE. All right, sir.

The subject today is the development, growth, and state of the atomic-energy industry. Within this I believe we are really concerned with our international position and whether we continue the trend toward a free industry, or revert to greater Government influence and control.

WHAT GENERAL ELECTRIC HAS DONE

In the 3½ years since the passage of the 1954 act, industry has moved effectively toward establishing a base in development, design, manufacture, and use of power reactors.

As part of this picture, General Electric has wholly financed and put in operation—

1. A plant headquarters for engineering and fabrication of reactor components and fuels. Our San Jose facilities represent a total investment of approximately $6 million.

2. A major laboratory for research and development. The Vallecitos Atomic Laboratory has been constructed and is now in operation. The company has spent approximately $14 million for this laboratory, which is the largest privately financed atomic research facility in this country. The laboratory contains three nuclear test facilities, an experimental physics building, and a radioactive materials building. A materials testing reactor is now under construction.

The Vallecitos boiling water reactor is part of this laboratory. It began operation on October 24, 1957. This is the country's—and I believe the world's—first all privately financed power reactor.

The company's atomic power equipment department, which operates the San Jose plant and the Vallecitos laboratory, and which is responsible for our commercial business, is engaged in a number of projects. Of these, the largest is the Dresden station for Commonwealth Edison.

We might briefly go through a series of pictures. In the first picture all of the buildings except that cut off at the left of the picture are exclusively on atomic energy work.

The second picture is an aerial view of the laboratory with which a number of you are familiar.

In the right-hand corner is the ground preparation and initial construction work for our materials testing reactor.

The third is the Vallecitos boiling water reactor.

And the fourth is quite a recent picture at Dresden showing the sphere practically completed and the turbine and other buildings roofed in, and going right ahead.

The Dresden plant is well along and its progress is covered in the statement of Mr. Gale, of Commonwealth Edison. The project is on or ahead of schedule. Construction is about one-quarter complete. Design is about 80 percent complete. As to cost, previous statements to the committee and our 1955 cost estimates, which included factors for contingencies and for escalation of labor and material costs, are still holding up.

Over the past year our atomic power equipment department has prepared proposals for numerous other projects. One of these is covered by the recent announcement of Pacific Gas & Electric Co. The plant to be built for Pacific Gas & Electric represents major technical progress. As announced, we hope it will lead to another and larger step which Pacific Gas & Electric is contemplating.

In total, General Electric is going ahead in the atomic field with solid, substantial, costly programs.

I would like now to turn to some of the issues mentioned in your invitation to testify in these hearings. Specifically, I would like to

discuss acceleration, Commission contract policies, work on the thermonuclear process, the international situation, and incentives and controls.

I. Acceleration

IS THERE A NEED FOR ACCELERATION?

I believe that the demands of the internal economy do not now require a new source of energy for electrical power production, and will not for many years. This country has a great deal of coal and uses it more effectively than any other nation to produce power.

The international situation may be a different matter.

Many other countries have fuel needs which are greater than ours. Some nations may lead us in use of nuclear fuel unless we employ artificial means to speed our undertakings. Artificial means might be fear of Government control, or they might be true incentives. I believe fear is wrong and in the end would never really produce the desired result.

Do we use the second alternate?—and if so, how?

Acceleration will cost money. If we are pursuing international goodwill as distinct from domestic economic objectives, it should be the taxpayers' money which is spent for this goodwill.

Congress and the executive branch must weigh competing demands for increased spending in many areas, atomic and nonatomic. There are many suggested programs for technical accomplishment designed to improve our international position. Congress and the executive branch must choose a selected few which are likely to be technically successful, to have the least negative side effects, to have a major favorable impact on the world, and which we can afford.

Let us examine acceleration in these respects:

1. My associates and I believe that at least boiling water reactor plants can be made economically competitive by a succession of major plants backed by a sound continuing development program.

2. The negative side effects of any acceleration program would only arise if talent were diverted which is necessary elsewhere—and I see no signs of this—or if the country reverted to increased government direction and control, and possible socialistic competition with industry; I believe this can be avoided if there is a will to do so.

3. Congress and the executive branch must judge the extent to which domestic atomic progress will have a favorable impact on international relations.

4. Congress and the executive branch must consider the cost and then make the final determination.

GOVERNMENT OWNERSHIP AND GOVERNMENT CONTRIBUTION

I believe that economical power cannot be achieved by development alone and that we are not too likely at this stage to achieve any quick major conceptual breakthrough of the inventive type.

In my judgment, a number of uneconomical full-scale plants will be built before one proves economical.

As I see it, the least benefits at the most cost would be accomplished by full Government ownership because—

1. Government ownership means that basic technical decisions will be made by a small group on a noncompetitive basis.

It also means, in many cases, detailed, expensive, and time-consuming supervision of the work. The country is likely to obtain better results if decisionmaking is decentralized and there is room for initiative and competition.

2. Government ownership opens up the preference issue and invites a public private power controversy. Building plants at Commission sites to avoid this denies existing utilities the opportunity to gain vitally needed experience.

3. Government ownership would leave industry in a state of uncertainty as to the long-range roles of Government and industry. It would discourage private effort.

Must Government contribution call for detailed, time-consuming Government supervision? Not if Congress doesn't require it. There is no need for such supervision if Congress clearly defines objectives because progress can be measured against these objectives. Government controls beyond a necessary minimum can defeat the congressional purpose rather than promote it.

PLUTONIUM PRICES

Alternate acceleration devices are artificially low AEC charges for fuel material or artificially high buy-back prices. However, if such incentives are to be but temporary, they tend to warp the technology.

I believe that AEC fuel charges should be based on a reasonable long-term appraisal of the cost of production. Equally I believe that if the country needs plutonium for weapons or weapons stockpile, the Commission should pay weapons value. Otherwise, the Commission should pay fuel value.

I would like to elaborate somewhat on this latter point.

If the Government determines that the country requires more fissionable material for weapons purposes, then the law might be amended to permit the Commission to provide long-term assurances as to purchase of plutonium at prices which fairly reflect its value for weapons purposes.

The prices established could be based on the Government's actual cost of production of plutonium, as determined from time to time, with adjustments for Federal income taxes, charges on fuel and interest on capital. The Government would be obtaining plutonium substantially at its present costs to the taxpayer.

At the same time, the plutonium credit would make construction of nuclear plants more attractive financially. I would hope that any such program would be worked out in cooperaton with the power industry.

In concluding on this acceleration point, let me say:

An acceleration program will cost money and must be weighed against other ways to spend money. If considered necessary it can and should be accomplished more cheaply and with less disruption than by Government ownership and control.

II. Commission Contract Policies

You have invited comment on Commission contract policies and particularly on fee and cost reimbursement policies.

The national policy in Commission work is to place basic reliance on private industry. Profit is an essential ingredient of the private industrial system. Commission policies on compensation of contractors should properly recognize this.

Business has many responsibilities—to its owners, to its employees, to its customers, to its suppliers, to its community neighbors, to the general public, and, not least of all, to the national defense.

But in our system, business cannot perform any of its responsibilities unless its contributions are rewarded by profits. Without profits no business enterprise can continue to exist, much less provide a return for its shareowners, or attract essential new capital, or maintain programs of research and development. This country's present industrial competence is based on past profits.

In undertaking work for the Government, any company like General Electric is obliged to devote to the work valuable and scarce resources of managerial and technical personnel. In doing so, it foregoes the opportunity to employ these people in commercial business where experience shows that the prospect of a return is far more inviting. It is on the talents and efforts of such people that the Commission and the country must rely.

The fees paid by the Government should provide reasonable compensation for the managerial and technical contribution made by the contractor.

It seems likely that for quite a long period of years Government-financed work will constitute a considerable part of this country's total industrial effort.

In performing this work, the Nation will have to rely on the effective functioning of private industry. This country's private industrial system functions best if there exist the incentives and rewards which are the key to its success in the past.

I believe that most rapid progress would come from use of the same incentives.

The Defense Department has established fee and cost reimbursement policies which come much closer to recognizing these considerations than do AEC practices. There is a greater readiness to provide fees which bear a more reasonable relationship to the value of the contractor's contribution. There is also a greater readiness to allow for real, even if indirect, costs in performing Government work.

It should be emphasized that unless indirect costs are properly reimbursed, so-called fees are not a measure of profit. They may simply conceal the fact that work is being performed at no profit or at a nominal profit.

Yet even in the area of the Defense Department, industry generally believes that true profit is so low as to make such business marginal. We believe that during the past 10 years there has been an erosion of the incentives which attract our most qualified concerns to Government work.

A number of companies have been willing to take on Commission work at a loss or at no profit or at a nominal profit. In part this has been because of patriotic motives. In part it has been because the dual system of Government monopoly and secrecy produced a situation in which for years the only way to obtain access to vitally important technology was to become a Commission contractor.

Today it is still true, although to a lesser degree, that the Commission has a dominant role in the atomic market.

As I have indicated, one of the most valuable assets of any enterprise is its resources of managerial and technical personnel. Presently, General Electric, for example, employs in Defense Department work four times as many technical graduates per dollar of sales as it employs in commercial work. The comparable ratio for Commission work is not 4 to 1, but 8 to 1. Can industry be expected indefinitely to utilize these scarce and valuable resources of people for little or no return?

None of this is said critically. A number of historical factors have contributed to bringing about the current situation.

Also, the Commission has an obligation to make bargains which are reasonable from the taxpayer's point of view. But we have reached a time when a reappraisal by the Commission of its policies in compensating contractors is in order. I understand such a reappraisal by the Commission is in progress and am much heartened by this fact.

III. Thermonuclear Power

We at General Electric share the opinions about the prospects for thermonuclear power which have been expressed by the Commission on many occasions. We are impressed by the virtually inexhaustible energy source which thermonuclear power would provide, by the potential relative freedom of a thermonuclear powerplant from problems of radioactivity, and by the possibility of directly converting part of the heat generated by fusion to electricity.

On the other hand, we can foresee certain types of engineering problems in thermonuclear powerplants which could conceivably means that these plants, even if technically feasible, would not be able to compete economically with fission plants so long as a relatively inexpensive supply of fissionable material is available.

We would not consider it wise at present to curtail in any way our efforts to make fission power a commercial reality because of the remote possibility that fission plants would be rendered obsolete by thermonuclear plants in the near future. At the same time, however, because we are vitally interested in new and improved methods for the production of power, we are pursuing the study of thermonuclear power as a research opportunity.

In addition, thermonuclear technology as now envisaged is fundamentally an electrical technology. The problems of producing large magnetic fields, of controlling electrical discharges in gases, and of storing and switching large amounts of electrical power are ones which we in the electrical industry have studied for many decades. Hence, we feel that our industry and our company have the background and competence which will enable us to play important roles in the development of thermonuclear power.

The participation of General Electric in thermonuclear research is of two types:

First, we are engaged in certain activities which are financed by the Commission;

Second, we have initiated an entirely self-funded fusion research program which, though modest in size, is expected to make a substantial contribution to thermonuclear technology.

Our willingness to go ahead with our privately financed program expresses our conviction that fusion power, as well as fission power, can in the long run be most effectively and economically brought to maturity if a major role is played by industrial organizations that hope to profit by the ultimate commercial application.

Our decision also expresses our belief that it is the intent of Congress to preserve the traditional framework of incentives and opportunities which justify and stimulate the risking of substantial private capital in new enterprises.

The General Electric supported research in thermonuclear processes is being carried on in the General Electric Research Laboratory in Schenectady, N. Y. The research laboratory group has been engaged in studies to determine those areas of thermonuclear research where they are best qualified to contribute, in assembling equipment, and in initiating experimentation. It is our hope and expectation that the work of this group will significantly enhance the national stature in thermonuclear development.

The civilian access program makes it possible for our scientists to obtain information from the Commission in the category of thermonuclear processes. Because of the extensive thermonuclear research now in progress under Commission sponsorship, and in Great Britain, and because of the rapid development of new concepts and viewpoints, the timeliness and completeness of the information available to us is particularly pertinent.

We are appreciative of the Commission's efforts to supplement the topical reports available to the civilian access permittees by making it possible for us to visit their Sherwood laboratories on appropriate occasions and for recently conducting a briefing meeting in Princeton for the civilian access permittees. We hope that the Commission will find practical ways of increasing the frequency and scope of such meetings.

We furthermore would welcome consideration on the part of the Commission of methods for reducing the time required for technical reports to be made available.

Continued attention on the part of the Commission to the problem of dissemination to legitimately interested organizations of information obtained in its own program or through exchanges under the agreement with the United Kingdom, is essential to establishing in the field of thermonuclear processes the atmosphere of free scientific interchange characteristic of other areas of industrial technology in which the United States has led the world.

IV. International Prospects

You have invited comments on the international situation. Here I believe we must recognize candidly the major obstacles to the development of a substantial international market. The fact is that except for Britain, and possibly Russia, major atomic power development in other countries is still in the research, development, and planning stage.

A number of factors account for this:

1. Foreign customers are, in many cases, reluctant to make major investments in plants, the economics of which are still unproved. They are uncertain as to whether any type is as

economic, and as to how United States types stack up against British designs. These uncertainties make for delay in actually ordering equipment and beginning work.

2. The normal complications of doing any kind of business abroad are, in the case of the atom, compounded by a number of additional governmental and intergovernmental problems. Working out solutions to these problems has been a slow process.

3. There are still no generally applicable solutions to the liability question.

4. As far as United States designs using enriched fuel are concerned, many foreign customers desire from our Government long term assurances as to—

(*a*) Availability and prices of fuel;

(*b*) Repurchase of plutonium at firm prices; and

(*c*) Availability and charges for reprocessing services.

5. There are financing problems in some cases, and dollar shortage problems in others.

6. I think that it is unlikely that over any long period of time this country will supply to advance countries a major part of their nuclear powerplant equipment, any more than we now supply a major part of their steam boilers, their turbines, their forges, or their ships. The United States is a high cost producer of capital equipment. Moreover, other advanced countries have the will and the resources to develop engineering and manufacturing capabilities of their own.

V. Incentives and Controls

I would like in closing to emphasize some general factors I think important and which bear on the problem of reversion to increased Government control or continued progress toward a normal industrial pattern.

If we lag behind in any program you consider needed by this country, let us look at three factors:

1. Are the objectives clear or hidden in secrecy or vacillation?

2. Is the program organized so as to use the strengths of our industrial system? Or does industry have to conform to detailed controls as in a planned economy?

3. What are the comparative incentives of the program—and particularly profit—as compared to other activities also considered needed by our country?

I believe lagging programs usually are tangled in one or more of these three problems.

Let me here introduce a concept about which I believe many of us in industry are too reticent before you.

This country has fewer people than Russia and no more natural resources. We are concerned about our comparative performance in education. Stacked up against our rivals, where are we strong? The answer is, in our industrial system.

What has sparked our tremendously productive industry? Hope of reward in the form of profit, combined with decentralized planning and hence real competition.

I believe that we will make much faster progress if we rely on the incentives which account for our past progress, rather than try to accomplish our aims by elaborate Government controls.

The point is not that there should be no controls, but that they should not exceed what is required to carry out your objectives.

All Government spending is to purchase something and we should keep our eye on the purchase and its worth. Generally, Government control should be simply the necessary authority to make a good purchase. It varies by the purchase to be made. In every event, however, it should be the minimum adequate to make the value determination.

All beyond this is triply wasteful, in Government costs, in increased industrial costs, and in the irreplaceable value, time.

These are principles. As I see it, they indicate as proper the whole range from detailed control where objectives are unavoidably in a state of flux to a very minimum as I advocate in the race for economic electric power, where it should be possible to lay out a long-term objective and measure progress periodically.

Under the free-enterprise pattern, our industrial system out produces Russia many times. Let's recognize this strength, and use it at its highest effectiveness for the national good.

Chairman DURHAM. Thank you very much, Mr. McCune. You have discussed the matter very thoroughly and have brought out some very interesting points.

Mr. Holifield, do you have any questions?

Representative HOLIFIELD. Yes, Mr. Chairman.

On page 2 of your opening statement, Mr. McCune, you speak of the Vallecitos boiling water reactor. What was the cost to the company of that reactor?

Mr. MCCUNE. The cost to the company of the reactor?

Representative HOLIFIELD. Yes.

Mr. MCCUNE. I think we have made a public announcement on that.

Representative HOLIFIELD. I think you have. I have just forgotten.

Mr. MCCUNE. It is in the order of about $2½ million. We did make an announcement of the cost. I do not have it in my head at the moment.

Representative HOLIFIELD. About $2½ million?

Mr. MCCUNE. About $2½ to $3 million.

At the time we made the announcement we explained what that meant.

For example, that did not include the site, which is part of our laboratory, and so forth.

Representative HOLIFIELD. What production kilowatt is that?

Mr. MCCUNE. That plant is designed to produce 5,000 kilowatts through a turbine which is owned and operated by the Pacific Gas & Electric Co.

The reactor portion is capable of producing substantially more energy than that.

Representative HOLIFIELD. With the same core?

Mr. MCCUNE. With the same core. It is actually licensed for 30,000 thermal megawatts now. But we can run the turbine at full power and still spill some steam as well. I expect it will go higher, substantially higher.

Representative HOLIFIELD. You spoke of the announcement of the new reactor for the Pacific Gas & Electric Co. I would like to ask you 1 or 2 questions on that.

Has the GE figured this contract on the basis of making a normal profit?

Mr. MCCUNE. The General Electric does not have the contract for this plant, Mr. Holifield.

Representative HOLIFIELD. Does it have for the reactor?

Mr. MCCUNE. We are the supplier to Bechtel Corp., which has the prime contract.

Representative HOLIFIELD. The Bechtel people are the ones who are building it?

Mr. MCCUNE. The Bechtel people have a prime contract with the Pacific Gas & Electric Co. in the normal way that the business is done and we will be a supplier of equipment to the Bechtel Corp.

Representative HOLIFIELD. Have you supplied that to them on the regular financial basis?

Mr. MCCUNE. Yes.

Representative HOLIFIELD. In other words, you make a profit on those parts you supply them?

Mr. MCCUNE. That is not a contribution job.

Representative HOLIFIELD. You are not contributing to that?

Mr. MCCUNE. Well——

Representative HOLIFIELD. I mean you are not making a financial contribution?

Mr. MCCUNE. We are not making a definite financial contribution on that specific job, no.

Representative HOLIFIELD. On this particular project what is the assumption for the buy back of plutonium? Is it in the nature of $12, or $30?

Mr. MCCUNE. Mr. Holifield, you will have to ask the Pacific Gas & Electric Co. for the figures on plant economy, the overall plant cost, on the relative cost of their fuel, which are all figures which have been developed by the Pacific Gas & Electric Co.

Representative HOLIFIELD. You would also include amortization and depreciation in that?

Mr. MCCUNE. All the plant figures have been developed by the Pacific Gas & Electric Co.

Representative HOLIFIELD. You mentioned the belief that you have in the boiling water reactor plant in the future. The committee, of course, I think, shares your confidence in that particular type of reactor, but there are also other types in which other manufacturers seem to have equally as strong allegiance to or confidence, such as the sodium-type plant that North American is interested in.

Of course, the committee is faced with the problem of supplying authorization money and research and development for all these types and the fuels that go along with them.

Mr. MCCUNE. You notice I said at least boiling water reactor. I meant the "at least."

Representative HOLIFIELD. You make the following statement:

Government ownership opens up the preference issue and invites a public-private power controversy. Building plants at commission sites to avoid this denies existing utilities the opportunity to gain vitally needed experience.

Mr. McCUNE. I probably should add—

might deny the opportunity for them to contribute the experience they have.

Representative HOLIFIELD. It opens up the public-interest problem, too, on the other side of the question.

Spending taxpayers' dollars to produce 95 percent of the plant, for instance, it opens up the problem of the public interest as well. That is on the other side of the coin.

Now, on plutonium prices, you speak of long-term contracts for buyback of plutonium. This brings up the problem of Government assuming longtime contracts on the basis of an unknown factor of predictability as to how much of it we are going to need and for what purpose we are going to need it.

So, assuming the 15-year buyback at $30 on which a company would base its financing of its capuital investment assumes a period of time there which is long in relation to the speed of advancement of the art.

It also involves the Government looking into the crystal ball and anticipating what it will need down the path of 10 or 15 years from now when many things may happen.

We may not need more material for weapons use.

We may have enough at that time due to the changing international situation. We may or may not be able to develop a fuel value.

All these things are involved in your suggestion that we have a longtime buyback at a price.

Mr. McCUNE. You know, Mr. Holifield, I have tried to say this, that what I would like to see is the prices of uranium 235, the buyback prices, realistic, however that might be.

If there is a long-term need for plutonium for weapons, then it seems to me that plutonium is a commodity that is an important part of this activity and the thing to do is to try to get the price right.

If there is no long-term requirement, it is very clear, I think, that anything above the fuel value is a straight subsidy.

I have said that I do not think we should apply subsidies in order to get a value on plutonium which is way out of line because that will simply warp the technology. If you put a high enough value on plutonium you end up with Hanford-type reactors, which I think are more efficient than any other for making plutonium.

But there is this point: Since industry generally cannot get information as to what the future market is likely to be, industry generally does not know what the weapons program is, nor do I think they should.

Representative HOLIFIELD. Neither does Congress. We cannot predict that far in advance.

Mr. McCUNE. The question that I think has to be wrestled with is: Is it better to let industry guess or to let Congress guess, or for Congress to make the guess, or just do nothing.

This is an either-or. I am not telling you how to do this. This is an either-or.

But to the extent that that is not done the question of the value of plutonium is a wide-open question to the power industry as I see it.

Representative HOLIFIELD. Well, either-or—I think there are other alternatives than the Government committing itself to a 15-year contract on the buyback of plutonium when it does not know whether it will need it, 5, 8, 9, or 10 years, or 15 years.

Mr. McCUNE. Well, if it is realistic to think that we need it for 5 years, then I would suggest that the price for 5 years be set on the basis that I said.

If it is realistic for 10 years or we don't know, maybe we need a statement that for 10 years it is this way and then we don't know.

Mr. HOLIFIELD. The committee has not been able to get any guidance on this from either the Commission or the Defense Department, any quick objective.

I am showing you the predicament that the committee is in.

Mr. McCUNE. I am not arguing with the committee. I am saying that is one of the unknown variables which affects the speed of the program.

To the extent it is unknown it becomes to some extent a factor which delays things.

Representative HOLIFIELD. That is right. Particularly if you depend upon building an artificially predicted level of demand when you have no real facts to back you up in setting it and you contract on governmental contracts on the basis of a guess in order to achieve something other than the main objective, which is to secure a certain amount of plutonium.

In the Edison Electric Institute's survey of February 21, 1958, the following paragraph appears on page 8, and I am going to read it to you and ask you if you would like to comment on it:

> The price of plutonium and uranium 233. The buyback price of plutonium and uranium 233 can, in the foreseeable future, have a considerable effect on the selection of reactor types and fuel cycles. For example, at a buyback price of $30 per gram there would be no incentive for the development of reactors which could use plutonium when uranium 235 can be obtained at $17 per gram or less. At the $30 price, reactors producing plutonium and power can be anticipated in which the net fuel cost will be no more than 1 to 2 mills per kilowatt, which compares favorably with conventional fuel costs anywhere. If the buyback price for plutonium is higher than for uranium 233, it will act to the disadvantage of reactors which use thorium as fertile material.

Do you have any comment to make on that?

Mr. McCUNE. That includes some calculations. Since I have not read that specific article, I cannot check the calculations, Mr. Holified.

I think they are saying though, are they not, much of what I have been saying that buyback prices have a very substantial effect on the business.

My conclusions on that are, let us as well as we can, get prices to truly reflect the long-term picture and they will have a right effect on the business, whatever it is. Whether it be U–233 or plutonium, or whatever it may be.

Representative HOLIFIELD. In your section on "Incentives and controls," you ask three very pertinent questions. The first one: Are the objectives clear or hidden in secrecy or vacillation?

Certainly the objectives are not clear as far as this committee has been able to determine. We have not been able to obtain clear objectives.

Time schedules in regard to prospective reactors of a certain class: I agree with you that those three questions you have set out there or principles you have set out there, are very important and should be answered before we can go ahead.

That is all, Mr. Chairman.

Chairman DURHAM. Mr. Hosmer.

Representative HOSMER. No questions.

Chairman DURHAM. Mr. McCune, on the contract policy which you refer to here, AEC had a group together on this licensing program of the entire industry. Do you think such a meeting would be to the advantage and desirable to the overall contract policy of the Commission?

Mr. MCCUNE. I believe that meetings between the industry and the Commission would be quite helpful. I think the people on the Commission side are not one bit different from the people on the industrial side. They are just as intelligent; I hope both sides are just as honest—I am sure they are.

Whenever you have a difference of opinion, then your experience has led you to different conclusions. The only way you fix that up to get together and talk over your experiences.

Chairman DURHAM. I do not think that the Commission has at least said anything, or announced anything, like that in the future so far as I know.

Do you know whether they have, or not, or are thinking of such?

It seems to me a good idea on this policy of licensing, that is why I ask the question.

Mr. MCCUNE. On the policy of licensing?

Chairman DURHAM. Yes, when they get together to discuss it fully.

Mr. MCCUNE. We have had some informal discussions. We have had a number of informal discussions at which groups have, I am sure, said that we thought we could be helpful to the Commission if we were consulted on policy.

As far as I can see, the present Commission is of a disposition to accept that and would like to have more of it and we have to get mechanisms arranged so that we can do it.

Chairman DURHAM. You spoke to the matter of trying to promote this foreign trade in this atomic field. Do you have any ideas whether or not the policy of outright sale or lease would be any advantage to industry in promoting business overseas?

Mr. MCCUNE. Outright sale?

Chairman DURHAM. Outright sale to them, or lease. I am speaking of fuel.

Mr. MCCUNE. Of enriched fuel?

Chairman DURHAM. Yes. That seems to be one of the problems that has been facing industry over there for quite a number of years. It was brought out in discussions before the committee that most of the foreign countries were worried because of the fact that they have to depend on us for the fuel and long-time commitments.

They are not going to go ahead with their plants until arrangements are made to supply the fuel from some source somewhere.

Mr. MCCUNE. I think that is of particular importance in connection with whether or not they adopt our technology. I have never yet seen a reactor of any kind which could not be improved by the use of enrichment. I have no way to determine the figures which would show what the cost per installed kilowatt in a several million kilowatt program would be of such a plant if provided by Europe.

But it seems to me inevitable that Europe must go to the lowest capital cost way of producing economic power. They must determine whether this involves long-term commitments from the United States

for enriched fuel, or producing their own plants for making enriched fuel, or going the natural uranium route.

My own belief is that the natural uranium route—and this is simply individual belief—will prove more expensive in capital costs than that which can be accomplished by obtaining enriching material from the United States at our cost, or possibly providing the plants themselves.

But I do not have the figures on the latter part because that is classified information.

Chairman DURHAM. Of course, the question is before the committee at the present time on this international cooperation, which was part of the meeting in Paris last September.

It seems to me that these programs will pretty nearly bog down unless some action is taken at some point. They need the power over there. They are going to get the experience somehow by building the reactors and at the present time they are not in a position, they have no incentive, to build reactors to produce power with.

It seems to me that our industry as well as our own program would gain a lot trying to solve this problem over there to get something going.

Mr. MCCUNE. What I put in this testimony is essentially a report on the trip of a number of our people to Europe for the purpose of obtaining business, but it is intended to report those things which people in Europe brought up as deterrents.

Chairman DURHAM. This is your own company's experience this past year?

Mr. MCCUNE. What I put under this paragraph 4 is what was brought up to our people when they visited Europe.

Chairman DURHAM. What do you point to as the primary problem? Is it a matter of dollars, or the lack of interest in this development of power?

Mr. MCCUNE. You mean which of these is the most important?

Chairman DURHAM. Yes.

Mr. MCCUNE. I wish I could give you that specific information.

I think, No. 1, they are reluctant to make major investment in plants, the economics of which is still unproved. That is a major point.

I think the second, that the complications of doing any kind of business abroad being compounded by the necessity of reaching working agreements between governments, is of great significance.

Chairman DURHAM. You know, the President asked for about $4 billion this year to help stabilize their economy.

Do you have any opinion whether we could invest any of this fund wisely in carrying out the program?

Mr. MCCUNE. My personal belief is that the things that people appreciate the most—and I do not think it makes any difference whether it is individuals or nations—are the things that they need the most. They are generally willing to pay for the things they need the most.

Chairman DURHAM. They certainly need energy over there at the present time.

Mr. MCCUNE. So I would doubt whether it was necessary to make any billion dollar contribution to get them something that they need very badly.

When you are talking that type of money, I would expect the net result would be something that they did not need so badly.

Chairman DURHAM. Of course, there has been a lot of criticism of some of the things we have planned which have not proven so fruitful. It appears to me that any country that expects to advance economically, I think it is historic here and in all parts of the world that where they have a shortage, they always have a fringe economic condition, they do not have a sound economy.

That is pretty historical, is it not, around the world?

Mr. MCCUNE. Yes.

Chairman DURHAM. I feel if we are going to spend the money, which we have been doing, we ought to put it in the right spot.

It seems to me this is one of the spots where it would do some good. I am expressing my own opinion, not the committee's opinion.

Mr. MCCUNE. It seems to me that is the peculiar responsibility of the Congress to choose between the competing demands and to try to obtain that which is the most productive for the country.

Chairman DURHAM. Of course, Congress can do a lot of talking here about power energy and it has been discussed about as much as any other subject in Congress, but we have to look to the people in this field, such as you, to come and guide us as to whether or not things are worthwhile or no good.

We try to get the views of the people who are experienced in the field.

Mr. MCCUNE. Maybe a conclusive answer would be this:

I have little doubt personally that there are a substantial number of countries outside the United States who do need and would appreciate and are appreciating the help they are getting in the atomic energy program. I think there are a number of things, such as the liability question, the necessity of obtaining time consuming governmental agreements, the open question as to where they are going to get their fuel for the life of the plant which have to be resolved if there is to be any speedup in this at all.

I do not think that money alone is the answer.

If these are out of the way, then it seems to me the question is do we also have to spend very substantial sums of money in this country in order to do this.

But right now, unless a government such as ourselves were to give another government outright something, I think we would still have the problems of licensing, which are unknown, and which have held us up in this country, the problems of fuel supply, the problems of liability protection on both sides, with us for quite some time to come as delaying factors.

I think until these are fairly clearly resolved, I don't see how you or we can determine, in talking about a program which costs the taxpayers a great deal of money, to help in a large or only a small amount.

Chairman DURHAM. I was not putting it exactly on the basis of one particular program. Let us say you adopted a policy of trying to help the economic condition of those countries.

Mr. MCCUNE. This would help the economic condition of any country; that is correct.

Chairman DURHAM. Speaking of this fuel situation I do not think anybody expects it to get any better in Europe. That applies to all the fossile fuels.

Mr. Holifield?

Representative HOLIFIELD. You have set out in your international prospects section, chapter 4, six very important points, Mr. McCune. In the preliminary statement I think you made the claim of no immediate domestic need for the acceleration of this program, and that if there be a need for acceleration that it would rest on international considerations.

In your pointing out of some of the problems in paragraph 6, you say:

> I think it is unlikely that over any long period of time this country will supply to advanced countries a major part of their nuclear power plant equipment, any more than we now supply a major part of their steam boilers, their turbines, their forges, or their ships. The United States is a high cost producer of capital equipment. Moreover, other advanced countries have the will and the resources to develop engineering and manufacturing capabilities of their own.

Are you not in effect saying there that when you consider all the factors that are involved there actually is going to be a limited foreign market for American manufactured reactors.

Mr. MCCUNE. You notice I qualified that. I said advanced countries.

Representative HOLIFIELD. I know that.

Mr. MCCUNE. In those countries that is my belief.

Representative HOLIFIELD. Is not the same belief true in the less advanced countries because if the engineering capability is developed in the advanced countries we would be in competition with them for the nonadvanced countries and we would be face to face with a lower production cost from a competitive angle.

So you might as well include the nonadvanced countries as well as the advanced countries, as far as the competitive market is concerned.

Mr. MCCUNE. I think in terms of a market for capital goods, particularly of this type, there might be three classifications.

I believe there are many countries whose prime need is money to buy the equipment to use electricity.

You spend a good deal more money for things that use electricity than you do for the electricity.

Then there is another group of countries which have a great need for power which have substantial sources of income and dollar income from foreign products, from coffee, or things of that type, but do not have a highly developed heavy industry and they may or may not be good markets or the United States.

There is an export market in the United States for certain heavy equipment.

There is finally the country which has both a highly developed economy and a highly developed heavy industry.

I think we will always have a small percentage of that business in that type of country.

Representative HOLIFIELD. Looking at it on the very premises you have stated here, we will be up against a competition of advanced countries in their own markets who have a cheaper production cost than ours and we would also be up against that same competition in the struggle for trade with those countries who are not advanced and

who buy on a competitive market the nuclear reactor, and, therefore, it might be somewhat illusory if we think we are preparing American industry for a big export business.

This might be a temporary shot in the arm while these countries are obtaining this technology, this capability, but over the long pull it seems to me that your reasoning in paragraph 6 is a correct reasoning when we compare it with other manufactured articles of other countries.

Now, if that line of reasoning is true, I personally think it is, this puts us really in the urgency on the basis of not developing an export capacity, but it puts it on a struggle for political supremacy, for political prestige.

If there be an urgency, I say. As I visualize it, that struggle is with the Soviet Union.

Certainly England is one of the free nations and we look upon it from the standpoint of international prestige. If England or the United States would win, the free world would win in the development of advanced technology, but the real competition in this field, as I see it, to be established, would be the Soviet people who would use their techniques if they develop them for infiltration in the countries, first economically and later on in an ideological sense.

If our assumption be true, then the competition that we are really aiming at is the Russian competition rather than the English competition it seems to me.

Do you agree that that is a reasonable premise or reasonable assumption?

Mr. McCUNE. I believe that what we are talking about in the international field is international prestige. I agree with you that international prestige in the present atmosphere comes from doing things better, sooner, and more effectively than Russia.

I think that is the atmosphere we are in.

Representative HOLIFIELD. Do you not think that we have to adjust our thinking on the basis of some type of cooperative effort with the British rather than the business as usual competitive principle, allowing that to apply as we allow it to apply to washing machines and other things of a normal manufactured type, that this being an international urgency based on competition with the Soviet that we should have a very close working arrangement with the British and strive for the supremacy of the free world rather than maintaining this title competition between the English and ourselves which might slow up the race to obtain supremacy over the Soviet Union?

Mr. McCUNE. I would like to point out one thing there: that is that the British effort is what we in this country would call completely socialized. That is, as I understand the British setup, the British Atomic Energy Agency—I think that is the right term—has essentially set up a company for this business. This company is like the British Electric Energy Authority which operates as a company.

These companies are wholly Government-owned, however.

One of the great difficulties of our relationship with Britain is that in Britain we have a monopolistic company as the representative of their Government and we have a group of industries which are encouraged to form cartels.

Whereas, in this country, our Government is operating as a government, I hope, I am sure, and not as a corporation owned by the

Government, and we are dedicated to the principle not of cartels, but of free competition.

I do not know anything that is going to be harder than to meld those two things in an effective effort.

Representative HOLIFIELD. Is it true that there is an arm's length arrangement between the English Government and the electric utility manufacturing machinery people because, as I recall, the English Government charges royalties on Government-owned patents to these people.

Now, there must be a contractual relationship.

While they are very close together in their operation I cannot see that they are being closer than we would be if we subsidizing the machinery manufacturers in this country in their export business.

Then you have a very close tieup of your Government here with your local machinery manufacturer, even to the point of subsidy.

It has been expressed in this hearing by one industrial witness, for instance, that the cost per installed kilowatt is $165 for a conventional plant and $330 for an atomic plant, that the industrial company would make its contract for the $165 cost with a foreign purchaser and the Government would step in and pick up the other $165 of capital investment.

This has been one suggestion of American industry. This gives you a very close governmental tieup, as close as they have in England, I would say.

Another suggestion that has been made, we have a 15-year buyback contract on plutonium at $30 whether we are going to need it in 12, 13, 15 years from now, or not, and this buyback is in effect a Government subsidy to guarantee them their fuel and part of their capital investment.

So you are in effect setting up under a different form the same type or a very close type of governmental industrial concept that they have in England.

We give the industries their patent rights in this country free and England charges to their industrial companies a royalty charge on the patent rights.

So it seems to me that you are drawing a very fine line there when you try to differentiate between the proposal of a governmental American industry tieup and the English tieup in Great Britain.

I see very little difference there. You just approach it from a different angle.

The same results would obtain, which is governmental subsidy of a private industry group.

Mr. MCCUNE. Of course, I do not propose a Government subsidy.

Representative HOLIFIELD. What did you say?

Mr. MCCUNE. I was not the one who proposed a Government subsidy.

Representative HOLIFIELD. You have proposed it in some way. You proposed the long-term buyback.

Mr. MCCUNE. I said provided you need the material. If you need the material the long-time buyback is not a subsidy; it might be a bargain.

Representative HOLIFIELD. On the other hand, we do not know if we will need the material.

Mr. McCUNE. If we think we are not going to need it, I think it is quite debatable that we should enter into an agreement to buy it back abroad at unrealistic prices.

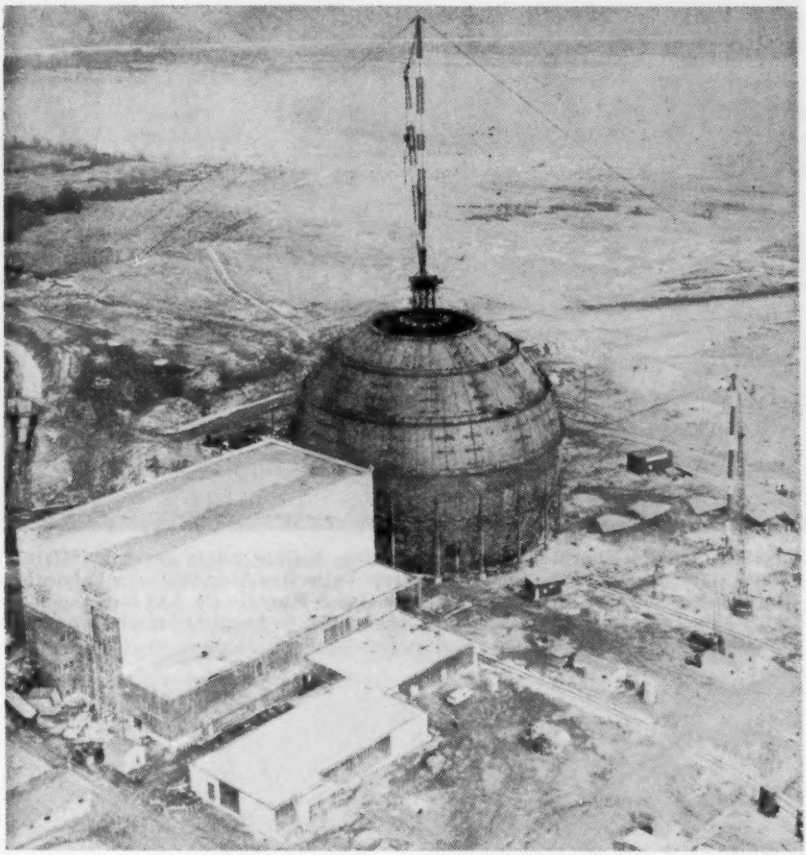
That is a straight subsidy. If the net result of that is to spend a million dollars and buy $2 million of international good will, that is a bargain; but that is the kind of a bargain the Government should make.

If you spend $1 million and get a half million dollars' worth of good will, it is a bad bargain.

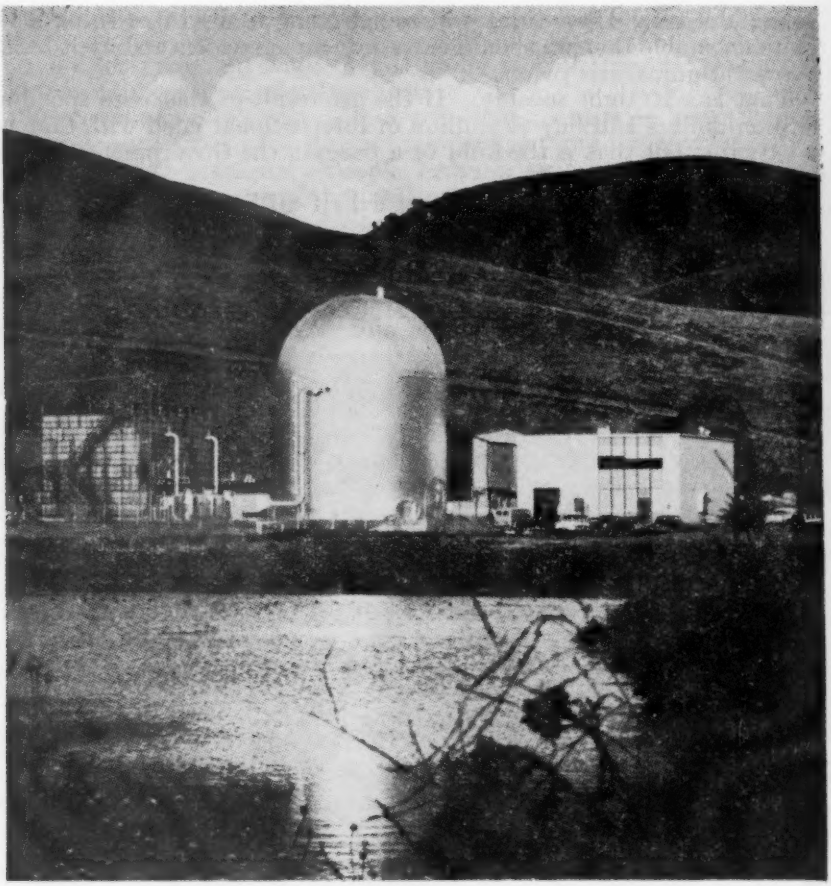
Chairman DURHAM. Thank you very much, Mr. McCune.

Mr. McCUNE. Thank you, Mr. Chairman.

(The pictures submitted by Mr. McCune follow:)



Aerial view showing progress in construction of the Dresden Station being built by General Electric Co. for Commonwealth Edison Co. The Nuclear Power Group is participating in this program in association with Commonwealth Edison Co.



Outside view of General Electric's Vallecitos boiling water reactor (VBWR). The VBWR is part of the General Electric Vallecitos Atomic Power Laboratory. A turbine generator provided by Pacific Gas & Electric Co. has been connected with this reactor for production of electricity to be distributed through the Pacific Gas & Electric system.

Aerial view of the General Electric Vallecitos Atomic Power Laboratory. The VBWR is located at lower left. The materials testing reactor (GETR) is shown under construction at the right. Other facilities (Experimental Physics Building, Radioactive Materials Laboratory, nuclear testing facilities, and office facilities) are located at the left center.

Aerial view of General Electric's Atomic Power Equipment Department headquarters and manufacturing facilities in San Jose, Calif.

Chairman DURHAM. The next witness is Mr. John Menke, president of the Nuclear Development Corporation of America.

STATEMENT OF JOHN MENKE, PRESIDENT, NUCLEAR DEVELOPMENT CORPORATION OF AMERICA

Mr. MENKE. I am with Mr. Hamilton this morning.

Chairman DURHAM. We welcome you back before the committee, Mr. Menke. Do you have a statement?

Mr. MENKE. Yes, sir.

Chairman DURHAM. You may proceed, Mr. Menke.

Mr. MENKE. My name is John Menke, and I am president of Nuclear Development Corporation of America—NDA.

Before going on with my views about a power program for the future, I would like to express our appreciation. It is far too easy to lose sight of the enormous amount that has been achieved in the civilian atomic power program of the United States in a relatively few

years. I would like to express my own strong feelings that the members of the Joint Committee and the members of the Commission and their staffs, have in fact done an outstanding job of public service in this field.

There is much to criticize in detail, but in the overall view I feel I must take this opportunity first to express the extremely high regard in which I hold the public servants who have arranged and directed our program.

I would like to speak with you on only one topic today—in support of a plan of action for a program that would meet our country's obligation for leadership abroad and which might, I think, find support in the Joint Committee and at the Atomic Energy Commission.

I shall speak of this plan concretely and as if my company would have a significant part in it. We would greatly want the honor and responsibility of participating in such a task. But I recommend this plan to you whether NDA can have a part in it or not.

Many of us in industry would like to see several different types of reactors supported through research, development and design, reactor experiments, and first test generations of full-size reactors. The United States has begun to take the light-water reactors through these first generations. Great Britain has begun to take the graphite reactors through their first generations, too.

I think it would be technically desirable to take 2 or 3 more types of reactors through this progression. A plan for such a broad 10-year program is attached herewith as a memorandum. However, I do not think that it is realistic to undertake the entire broad program at once; it will require time and much debate to forge it into useful form.

Instead, I recommend to you a 10-year program directed at hard accomplishment of just 1 more reactor-type now, this time specifically directed at our first objective, international leadership and help to our allies. We should separate the accomplishment of our undisputed first objective from the difficulties of decision in the larger program and begin now to get on with the first job.

To complete the array of reactors accomplished by the Western World, we should get started on a firm 10-year program for heavy water reactors. These reactors should be capable, when necessary, of burning natural uranium and should be capable also of delivering steam at modern conditions of high temperature and pressure.

Ordinarily, these reactors might operate more economically with very slightly enriched uranium—under 1 percent enrichment. The burned-up fuel discharged from these heavy-water reactors would not need to be chemically reprocessed, thus simplifying the fuel cycle problems and costs. Such reactors are certain to have strong international and domestic importance.

The program contemplated would include the basic research and development and design work, at least 1 small reactor experiment and 1 full-scale plant to be built in the United States, and 2 full-scale plants to be built abroad. The cost to the United States is estimated at $200 million, which bears a reasonable relationship to the almost $1 billion of materials already committed to the international program.

The Atomic Energy Commission would be called upon for low-cost, 4 percent rentals of fuel and heavy water, for design and development

funds, and, I believe and recommend, for 85 percent of the difference between the price of the conventional plants and the price of the nuclear plants included in the development program. No further long-term fuel subsidies should be grantd. No problem is anticipated in this cooperative program with the foreign third-party liability question.

I would recommend that such a planned, 10-year program for heavy-water reactors be cooperative and include, for example, the research experience of Argonne Laboratories, the Savannah River and Chalk River experience, and the development and foreign cooperation experience of NDA, and the experience of the ultimate utility users—domestic, such as the American Gas & Electric Co., and foreign, such as the interested groups in Belgium, Germany, and Japan. I would anticipate that the utility companies, and especially the foreign ones, would have significant numbers of engineers getting training on the job. NDA is currently engaged in such an international program with Belgium; we have come to understand both its difficulties, and they are many, and its benefits to all concerned. And those benefits are recommended most highly to your attention.

Equipment suppliers, both domestic and foreign, would also be called upon to develop and furnish items appropriate to their experience and to participate in the planned program. For example, in the case of foreign installations, foreign architect-engineers would be employed and foreign equipment procured with the foreign funds made available.

The program would remain open for interested and qualified participants to join at any time. Its purpose and schedule would be a published policy document displayed all over the world. The entire plan would be consciously coordinated to be a visible and concrete program of atoms-for-peace in action.

I have taken the trouble to review this with one of my associates, Dr. Eugene Wigner, and he would like to associate himself with the recommendation for an international cooperative program such as I have recommended to you.

Such a coordinated plan to move forward in clear response to our international obligations and to meet the needs of our allies would, I believe, be a useful and a feasible step now. It would, I believe, gather into it the enthusiasm and cooperation of the new Euratom and International Atomic Energy Authority organizations.

I have been asked to be brief. I have appended herewith a memorandum for the record with a fuller discussion of a broad program. Such broad programs, also discussed by others, should be the subject of careful, unhurried discussion. I strongly recommend the above-outlined $200 million heavy-water reactor part of the program to you for action now, administered in a manner to complete delivery on the promise in the President's 1953 speech to the United Nations.

Thank you.

Chairman DURHAM. Without objection, the other part of your paper here will be introduced into the record.

(The material referred to follows:)

Memorandum to: The members of the Joint Committee on Atomic Energy and the members of the United States Atomic Energy Commission

From: John R. Menke, president, Nuclear Development Corporation of America

Subject: Suggestions concerning the program for civilian atomic power development

INTRODUCTION

Much credit is deserved by the Joint Committee and the Atomic Energy Commission for their initiative and foresight in holding their recent informal meetings with the atomic energy industry. It has been a considerable privilege to be permitted to participate in these meetings. The thoughts which follow here have grown out of that participation. They are submitted in writing at the invitation of both groups.

The opportunity to speak on civilian atomic power development in something less than a public forum did provide an opportunity for us in the industry to speak most freely. It is particularly important to note that the ideas expressed in those closed meetings were more temperate and more constructive than many of the expressions frequently seen in the public mediums.

Before going on with my views about a power program for the future, I would like to express an appreciation. It is far too easy to lose sight of the enormous amount that has been achieved in the civilian atomic power program of the United States in a relatively few years. I would like to express my own strong feelings that the members of the Joint Committee and the members of the Commission and their respective staffs have in fact done an outstanding job of public service in this field. There is much to criticize in detail, but in the overall view, I feel I must take this opportunity to express the extremely high regard in which I hold the public servants who have arranged and directed our program.

It is natural that the time has come for reevaluation and for more planning. We are coming to the end of the first 5-year plan for 5 experimental reactors[1] which was started in 1953.

The purpose of this memorandum is to contribute to the outline of a plan for acceleration of the development of economically useful civilian atomic power. The mechanism for acceleration is agreed to be governmental aid, or subsidy. I will try to set forth my view of the objectives of such an acceleration, the technical substance of a plan, and the administrative mechanics of a subsidy.

OBJECTIVES

The objectives, as I see them, of an accelerated civilian atomic power development program are three.

First, the United States must help its allies, whose energy and fuel situations are precarious;

Second, the United States must display an even wider international leadership in its battle to win the uncommitted countries of the world to our philosophical view; and

Third, the United States Government must handle its subsidies in the atomic power program in such a way as to grow a healthy domestic industry capable of meetting the needs of our Nation in the decades ahead.

No program for development, acceleration, or subsidy can succeed unless it meets the tests of all three of these objectives.

SUBSTANCE OF A PROGRAM

The main element of a new program must be stability. By this I mean that the program must be laid out with completeness and thereafter be able to be changed only by a considerable and considerate action. Of course, there must be periodic reexamination of the program; this is already provided for by annual authorization and budget reviews on the executive branch side and by the statutory Joint Committee hearings and the authorizing and appropriations hearings on the legislative branch side. The stability needed for planning and operations could be accomplished either by a special statute or simply by a published program by both the Commission and the Congress.

It would appear that a sound plan should encompass at least the next 10 years. It takes 10 years to proceed from an initial feasibility study to an adequate test on prototype scale of a given reactor concept and then to progress through 2 or 3 succeeding generations of improvement.

---

[1] Experimental boiling water reactor, homogeneous reactor experiment, sodium graphic reactor experiment, experimental fast breeder reactor, Shippingport demonstration reactor. Subsequent additions: Organic moderated reactor experiment, liquid-mental-fueled reactor experiment.

There is no adequate or easy kilowatt yardstick for this program. One cannot say that the United States should commit itself to build or assist in the building of some specific number of megawatts of electric power from atomic energy per year.

In fact, it should be pointed out most strongly that no formula can substitute for the judgment of informed men. I frankly fear a formula-type plan because I doubt seriously that it will yield a sufficiently flexible and intelligent program.

The civilian atomic energy power program so far (the 5-year, 1953–58, plan) can be characterized as a broad exploratory or reconnaissance effort together with a useful first generation of 1 type, the slightly enriched, light-water-cooled reactor. The new program must continue the exploratory and reconnaissance expeditions at a reasonable level.

Within the 10-year (1958-68) program, at least 3 kinds of action should be taken:

First there is the need to continue the exploration of new concepts. This is an activity which must be conducted in two types of organizations. One of these is the national laboratories, but these should be limited to significant "frontier" research. I suggest they should have a limited role because the national laboratories per se do not directly meet our third objective of growing a sound, self-supporting domestic industry. The other types of organizations which should participate strongly in this exploratory activity, but on work which is nearer to actual accomplishment than the "frontier," are the engineering development and manufacturing companies.

The second activity which needs to go forward within the 10-year program is the construction by the growing reactor industry of appropriate reactor experiments to test out the new concepts which have been studied and found interesting. (It may not be necessary to build separate experiments for each new concept. A way is already being explored in the proposed ARBOR project to test a variety of members of the same family of reactors in a single testing machine. One should be cautious, however, about embracing this "reactor testing reactor" approach too completely.)

Finally, there is the obvious third necessary activity. This is the construction, again by private industry, of a certain number of generations of large reactors, which will test in every regard, including economics, the complete reactor concept applied in as nearly commercial a manner as can be done in the first generations. As an approximation, I would estimate that it would be desirable to build 2 or 3 or 4 different types of reactors and to build each of these on the order of 3 or 4 times in order to arrive at economic nuclear power in the United States in 10 years.

I can confidently recommend at least 2 of these 3 types to be built at full scale. One of them is certainly the light water moderated and cooled family of reactors which includes the PWR and the BWR, and on which we have already achieved the first generation.

A second type which must surely be included to discharge our responsibilities abroad is a heavy-water family of reactors. These reactors, I would think, would include versions cooled by water, gas, liquid metals, and quite probably steam. Studies of the water-cooled member of this family have been going on at Argonne and at Savannah River. A proposal from an industrial group is now before the Commission for a gas-cooled member of this family. My own company is carrying forward a liquid-metal-cooled version and has placed a proposal before the Commission for an experiment on a steam-cooled version. We are now studying the latter steam-cooled, heavy-water reactor jointly with the east central nuclear group, at private expense so far.

Room exists for useful controversy as to what other types should be carried through several generations: "Small" reactors, sodium graphite, fast breeder, gas graphite, etc. The Reactor Development Division should be asked to review the above recommendations and to make the third and possibly fourth choices to be started in subsequent years.

A first draft of a proposed schedule for a broad program is appended herewith: it is similar to schedules proposed by others.

It devising the 10-year program, it would be my expectation that it will cost on the order of an average of $200 million per year for 10 years; that is roughly $2 billion over 10 years. This is similar to other estimates in the industry.

This is an order of magnitude figure and the Government investment should be augmented by private contributions. It would make certain that at least 2 million kilowatts of electric capacity would be installed by 1968; my view is that one-half to two-thirds should be foreign installations. This would seem

to be a reasonable amount by comparison with other Government activities such as highway programs, general foreign aid programs, and nuclear development programs of new propulsion machinery for military vehicles which have obvious ultimate civilian application.

We need to remember that the reliable availability of adequate supplies of electricity in the United States but even more in the countries of our allies over the next decades is as much a part of our military strength during that period as the planes and the guns and all the other weapons.

TYPE OF SUBSIDY AND MECHANICS

There are certain principles which should be followed in devising a new type of subsidy. These principles are—

1. No subsidy should be so devised or so dispensed that it is automatically guaranteed or tends to go on forever.

2. Any subsidy must be fair; nevertheless, hard choices must be made among those who would receive subsidy. The criterion here of what is fair is to maintain healthy competition and not to allow monopoly. But competition is better served by 5 to 10 healthy competitors than by 30 weak ones.

2. Any subsidy must be fair; nevertheless, hard choices must be made between private power and public power. At least, changes in that ratio need not be brought about by the atomic-energy program.

4. The subsidy must flow because it fulfills a Government requirement, not because anyone has a right to it.

If this is to be an efficient program, it must be planned. This means that the Government must choose both what programs it wishes to support with subsidy and the organizations to which it wishes to direct subsidy. Not every applicant can be allowed to establish a right to subsidy, but at the same time any should be free to come in and try to make his case. Once the decisions are made, however, it must be made difficult to add or subtract from the list of chosen instruments.

The first question raised in devising a policy for the flow of subsidy is: Who should receive it? Quite obviously, there are many organizations which might choose to receive subsidy if the opportunity were presented to them. The criteria for choice should be twofold:

(*a*) The fulfillment of the immediate Government purpose to be achieved.

(*b*) The growth of a strong industry—always preventing monopoly.

The viewpoint of fairness should be the long-term best interest of the United States and its people, and not equal treatment to all companies. The latter position is impossible to administer in any subsidy program. Brief account might also be taken of each company's seriousness of purpose as evidenced by its private investment in advancing the field and by the proportion of its efforts devoted to the field.

Since it is not primarily the achievement of electric power from atomic energy in the United States in the immediate future which we seek, the second question is rather easier to answer: Which of the various possible types of organizations should receive subsidy? Those which can help us achieve all three objectives are those which design, experiment with, and build atomic powerplants. These include the national laboratories, private engineering development companies, and equipment manufacturers. (Companies, such as Du Pont and Union Carbide, which will not enter the reactor equipment business should not be given the privilege and practice of building reactors because such a policy does not match our objective of building a healthy industry.) The national laboratories, as I have indicated earlier, have an important role. But they, too, are not potential manufacturers or designers able to enter into a competitive domestic industry in the future. Therefore, the national laboratories must play a limited role. This leaves the commercial engineering development companies and manufacturers. One may also ask who then is to develop the operating data which we need for proper economic evaluation. The Atomic Energy Commission has had vast experience in obtaining qualified contract operators and has shown considerable ability in developing contractual structures which provide incentive to these contract operators.

The next question involved in the mechanics is: Should the subsidy flow to the capital portion of the plan or support the reactor operation? It is my view that the subsidy should flow mainly to the capital portion of the investment by reductions in the sale price through partial subsidy to the manu-

facturer. A partial operating subsidy may also be necessary during the test-operating period. The fuel-operating costs should be subsidized, if at all, for only a short period, under 5 years. Maintenance cost subsidies, if any, are more difficult to decide now.

The last question is: How much of the bill should the Government pay? I believe the Government should pay a large fraction (say 85 percent) of the difference between conventional and initial atomic-energy plant costs: The balance (15 percent) of the differential cost plus the equivalent cost of a conventional plant should be paid by the electric utility operator. This does not mean, however, that vigorous efforts should not be made to obtain further contributions from private funds where these funds are compatible with the objectives and do not result in directing the subsidy into hands not otherwise of the Government's choosing. Cash and a desire to diversify or foolhardiness are not the first-rank qualifications of a reactor developer or manufacturer.

Finally, as an observation, I would like to note that since our first objective is to help our allies, our program for the construction of power prototypes should include foreign technical participating personnel and should be so advised as to permit some significant portions of these plants to be built in foreign countries, both allies and neighbors and the uncommitted countries. By a significant portion, I would recommend that Congress make it possible for something like two-thirds to be built abroad.

By working now in Europe and Japan, domestic companies can gain experience to be used when atomic power is needed here in the United States.

Proposed schedule for 1958–68

[In millions]

	(*a*) Exploration											Total
	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	
Conceptual studies: Average of 20 per year at $250,000	5	5	5	5	5	5	5	5	5	5	5	50
Experimental studies: Average of 5 per year at $2,000,000 each	10	10	10	10	10	10	10	10	10	10	10	100
Reactor experiments: Average of 2 per year at $15,000,000 each	30	30	30	30	30	30	30	30	30	30	30	300
Materials	20	20	20	20	20	20	20	20	20	20	20	200
Physics and engineering	20	20	20	20	20	20	20	20	20	20	20	200
Operation	20	20	20	20	20	20	20	20	20	20	20	200
	(*b*) Hard accomplishments of 4 types by 1968											
500 EMW	1. Slightly enriched, H_2O (1958–63): 5 generations at $50,000,000 each (partially achieved already)											250
750 EMW	2. Natural, D_2O (1958–68): 5 generations at $75,000,000 each (start in 1958)											375
600 EMW	3. 3d type, to be chosen (1962–68): 4 generations at $50,000,000 each (decision in 1962)											200
200 EMW	4. 4th type (1965–68): 4 generations, small reactors, $25,000,000 each (decision in 1965)											100
2,050 EMW	Total											1,975

Chairman DURHAM. You have a very challenging statement, Mr. Menke.

Coming before the committee and outlining your thinking is very helpful to the committee in trying to arrive at the solution of these problems.

Has your company had experience in the heavy water field?

Mr. MENKE. Yes, sir. We are studying three heavy water reactors at this time. One is a sodium cooled heavy water reactor for the Chugach Electric Association in Alaska.

A second steam cooled heavy water reactor for the American Gas & Electric and Central Nuclear group and the third, a small training reactor for universities which has heavy water in it.

Chairman DURHAM. Were you here yesterday when Dr. Zinn made his talk on the program?

Mr. MENKE. No, sir; I was not here yesterday, but I have read part of the testimony that he gave.

Chairman DURHAM. He was speaking along this line, too.

Mr. MENKE. I believe he and I have large areas of agreement in what ought to be done for nuclear power.

Chairman DURHAM. Mr. Holifield?

Representative HOLIFIELD. I have no questions, Mr. Chairman. I have had no chance to look at his program which he has outlined and therefore I cannot question the witness on it at this time, but I will look into it very carefully.

I always appreciate having Dr. Menke before us. I will study your program.

Chairman DURHAM. Mr. Hosmer?

Representative HOSMER. I have two things I would like to ask you about, Dr. Menke.

You have worded your recommendation around the heavy water reactor because Nuclear Development Corp. happens to be in that field; is that right?

Mr. MENKE. No, sir; that is not right. I believe that there are three important types of thermal neutron reactors.

Representative HOSMER. You speak of it because you believe it is the best?

Mr. MENKE. Yes, sir.

My first sentence was that I recommend this program to you, whether or not NDA has a part to it.

Representative HOSMER. If this committee should approve the program, but not the particular reactor you have in mind, maybe a gaseous reactor, the principles which you enunciated would apply to some other type of reactor?

Mr. MENKE. Yes, sir; they do. That is a separate consideration.

Representative HOSMER. Now, the other thing I want to ask you about is this question of subsidy which is involved in your recommendation.

First, I want to ask you a hypothetical question: Suppose you want to buy a $2,000 automobile but you only have a thousand dollars.

My name is Sam. I say, "Well, I am going to help you out. I will give you 85 percent of that thousand dollars you haven't got to make the $2,000 purchase. In other words, I will give you $850 if you put up your $1,000 and get another $150."

So we do that. I give you the money. You go buy the $2,000 automobile.

Who gets the subsidy, you or the automobile dealer, from which you buy the automobile?

Mr. MENKE. Both of us get subsidized. The manufacturer gets the advantage of making the sale and the utility customer gets the advantage of the lower initial capital cost.

Representative HOSMER. What is that?

Mr. MENKE. He gets the advantage of a lower initial capital cost.

Representative HOLIFIELD. This man has the automobile in his agency anyway. If he did not sell it to you, he would sell it to somebody else. He is only getting an indirect subsidy if you want to call it that. You have bought the automobile with your money and my money from the third party.

Mr. MENKE. Yes.

Representative HOSMER. You are really getting the benefit of that subsidy; are you not?

Mr. MENKE. It is my opinion that both parties are benefiting by that subsidy.

Representative HOSMER. Even the supplier of the dealer?

Mr. MENKE. Yes, sir.

Representative HOSMER. Who gets the most subsidy out of it?

Mr. MENKE. That is a qualitative question that I do not feel qualified to answer. I think both parties get a very large benefit out of it.

Representative HOSMER. You are getting the automobile now, which you would not have had otherwise and you are driving around, enjoying it, and using it in your business and so forth.

Do you not think that is a little more benefit? You have a $2,000 product. Perhaps the dealer only got a $200 profit out of the whole thing.

Mr. MENKE. But the dealer is staying in the business. The dealer has had the advantage of the opportunity to build an important piece of equipment.

Representative HOSMER. He is having an advantage of having a market?

Mr. MENKE. Yes, sir.

Representative HOSMER. Then there is a splitting, then, of the so-called, at least the benefits, whether you want to call them subsidy——

Mr. MENKE. I would call them subsidy.

Representative HOSMER. All right.

When we sell one of these reactors to some foreign country under your type of arrangement it is actually the foreign government that gets the immediate and direct benefit of the product that is being purchased.

Mr. MENKE. Yes, sir.

Representative HOSMER. And insofar as the American manufacturer, at least part of the plant, he gets a substantial benefit out of it?

Mr. MENKE. Yes, sir.

Representative HOSMER. Do you think there is any way to cut that benefit out of the American manufacturer because the whole theory and reason for this subsidy is an international one connected with the United States prestige abroad involving leadership and being able to manufacture over there?

Mr. MENKE. I would not want to cut out the advantage or the practice of getting on with this business before it is economic here. That is another lesser motivation.

Representative HOSMER. In other words, that is part of the price we, as a nation, pay for buying international prestige in effect, with this so-called subsidy to the foreign country that buys it?

Mr. MENKE. We get another advantage. We get the practice of exercising ourselves in the industry before it is economic here.

Representative HOSMER. You feel that that is worth $200 million?

Mr. MENKE. Yes, sir.

Representative HOSMER. Let us take that full-scale plant which you have suggested be built here in the United States, and assume that that is built by a private utility and 85 percent of the cost in excess of the conventional cost is put up by the Government.

The private utility then gets the immediate direct benefit?

Mr. MENKE. Yes.

Representative HOSMER. Now, what is behind the private utility? I should say the customers are behind the private utility.

What the utility can obtain by way of rates a percentage of their investment. I presume they would not get a percentage of the investment on the Government subsidy.

Therefore, the private utility as such, or its stockholders, are not receiving a benefit from this deal.

Mr. MENKE. They are not receiving a benefit. They are getting a penalty from having a too high cost plant in their territory. They are prevented from having that benefit whether it is private or public.

Representative HOSMER. As I gather from your analysis of the proposal that it is subsidized, it is a fairly broad subsidy, not alone to the original party to the deal, but many of those behind him.

Mr. MENKE. Yes.

As a matter of fact, I would like to amplify that point.

The question of subsidy is a difficult one. I have been asked by this committee many times difficult questions on administering the subsidy and I have not had the answer. It has troubled me.

I have gone back to my old economics professor and asked him, "How do you handle a subsidy in a fair manner, in a honest and fair manner?"

I must admit he looked at me kind of peculiarly and he asked, "What do you mean, 'fair'? There is nothing fair about any subsidy at all to any recipient of the subsidy. The question to be answered is: Is it fair to the giver of the subsidy? Are you getting more for the United States and its people by granting this subsidy, than you would have if you did not grant it?"

You are buying something useful.

Representative HOSMER. It is not a program of subsidy as such, but an incident to a larger program.

Mr. MENKE. Exactly so.

Representative HOSMER. That has estimated benefit if you adopt it?

Mr. MENKE. Exactly so.

The question of fairness comes to the payor of the subsidy. Is it fair to him? The subsidy is never fair to the receiver of such a subsidy.

Representative HOSMER. Your purpose is to develop and accelerate atomic energy?

Mr. MENKE. My first purpose is to meet our international obligations. You have stated my second purpose.

Representative HOSMER. You say in order to do that you have to go through these generations of plants, prototypes, research and development, and construction of large-scale plants.

All right, somebody has to do it if it is going to be done.

Mr. MENKE. Yes.

Representative HOSMER. It is either going to be done all by private industry or by Government or by, in part, each.

Mr. MENKE. Yes.

Representative HOSMER. You have a partnership kind of suggestion?

Mr. MENKE. Yes.

Representative HOSMER. If we did not buy that it would not be done at all privately, then the other alternative is to be done all by the Government.

Instead of paying $200 million you would be paying in excess of a billion dollars or more; is that right?

Mr. MENKE. I believe that the most efficient way of doing it is jointly; yes, I agree.

Representative HOSMER. Thank you, Mr. Chairman.

Chairman DURHAM. Thank you very much, Mr. Menke. We appreciate your coming down before the committee.

The next witness is Mr. James R. Fairman, senior vice president of Consolidated Edison Company of New York, Inc.

Good morning, Mr. Fairman, we are glad to have you with us.

Mr. FAIRMAN. I have with me Mr. Arvin E. Upton, counsel to the company.

Chairman DURHAM. You may proceed, please.

STATEMENT OF JAMES F. FAIRMAN, SENIOR VICE PRESIDENT, CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.

Mr. FAIRMAN. My name is James F. Fairman, and I am senior vice president of Consolidated Edison Company of New York, Inc.

As the members of this committee know, our company was one of the first to announce its determination to construct a nuclear generating plant.

We appreciate this opportunity to appear before you today and inform you as to the status of our project, located at Indian Point in Westchester County, N. Y.

In our written report to this committee last year we noted that problems had arisen in our program and that difficult decisions were then being made. We mentioned, for example, a change in the fuel element from thorium-uranium metal plates to thorium-uranium oxide rods.

Some of the implications of these changes were broader than we realized last February, that is, a year ago. The changed design meant increased costs and delay.

As soon as the design change became definite enough to warrant it, we and our contractor, Babcock & Wilcox Co., prepared a new detailed cost estimate. The new estimate takes into account not only increases resulting from design changes, but also the general increase in the cost of conventional equipment and it now seems probable that our total plant will cost about $90 million.

After the revised cost estimate was completed, we negotiated new contracts with Babcock & Wilcox for research and development, engineering, and for the supply of certain reactor equipment and the first reactor core.

These contracts supersede the 1955 contract, which was written at a time when neither party had fully analyzed all the complexities of the job to be done.

Under the new contractural arrangements, we ourselves are assuming responsibilities corresponding to those of a general contractor on the project just as we do in conventional powerplant construction.

In the course of the design changes and the preparation of new cost estimates and new contract negotiations, work at the site was discontinued, orders on equipment were held up, and the pace of design work slowed for several months.

For example, design changes involved changes in the diameter and weight of the containment sphere, which necessitated holding up excavation and foundation work for the sphere until these design changes became final.

As another example, the critical experiment was originally set up by Babcock & Wilcox Co. to handle plate-type fuel elements and has been reset to handle oxide pins.

The new critical experiment has now begun as a result of the recent issuance by the Atomic Energy Commission of a revised license to Babcock & Wilcox Co. Much worthwhile information was derived from the work on the plate-type fuel elements, and this information will be of value in further experimentation.

I mention these problems without apology. When we made our original decision to construct a reactor in our territory, we knew there would be difficulties. Despite the difficulties, we believe we have made substantial progress toward our goal during the past year.

Fabrication of the reactor vessel and steam generators has begun in Babcock & Wilcox's shops. Detailed design of the pressurizer tank is underway.

The primary coolant pumps, the primary coolant piping and the control rod drives have been ordered from vendors. The functional design of the principal reactor building and the shielding and containment structures and systems and components auxiliary to the reactor is well along. This design is expected to be completed by the third quarter of 1958.

Research on fuel element materials and plant components continues at the Alliance, Ohio, laboratories of Babcock & Wilcox, and the in-pile irradiation loop facility has been installed at the materials testing reactor in Arco, Idaho.

The containment sphere has been ordered and contracts for all the major equipment for the conventional portion of the plant have been made.

As of February 1, 1958, we have committed or expended $48 million on our plant. Of this total, approximately $9 million has been spent, most of which was for engineering and research work.

I said earlier that our cost estimate had risen to $90 million. The estimated cost of the nuclear portion of the plant has more than doubled. About half of that increase is attributable to design changes, including an increase in the capacity of the plant from 236 megawatts to 275 megawatts.

Some of the purported increase may be theoretical since certain systems and structures were not considered in the original cost calculations.

Not all the ancillary features of the design of the plant have been settled. We must, for example, develop a detailed design for a waste concentration and disposal system.

We have continued our efforts to keep local authorities and the public informed on our program.

Booklets covering various aspects of the application of atomic energy to the generation of electricity have been prepared and distributed. They have been offered to listeners to the company's television programs, to customers who pay bills in company offices, and to public and parochial schools in our territory.

Over 1 million of the booklets have been distributed, 600,000 of these in New York City schools.

Speakers have talked to interested groups throughout the city and Westchester County. This activity was concentrated in the last 12 months. Company speakers appeared before 240 adult groups with an attendance of just over 14,000 people.

In Westchester speakers have also told the Indian Point story in 150 schools to more than 13,000 students.

Reprints of speeches and technical articles by company officials have been distributed to science teachers and others throughout the territory.

An exhibit highlighting our Indian Point project has been displayed all year at the New York Stock Exchange exhibit center, through which a steady flow of local and out-of-town visitors passes daily.

We had sponsored an atomic energy institute for 250 junior high school teachers at the close of 1956. This all-day meeting reviewed the entire field of peacetime applications of atomic energy and emphasized ways and means of teaching this new subject.

As a result of teacher interest in this institute, copies of the proceedings were made available during the past year, not only to those who had attended, but also to all other science teachers in our territory.

General interest in atomic energy has been sustained, and we have continued to supply information relating to Indian Point throughout the year to newspaper reporters and magazine writers.

We have not yet filed with the Atomic Energy Commission all the necessary papers to bring our application up to date in the light of our design changes, but expect to do so as soon as it is clear that these changes are firm.

On August 29, 1957, we wrote to the Commission suggesting that a series of informational meetings be held with the Commission's reactor development staff. Copies of our letter and the Commission's reply are being submitted for the record as a supplement to this statement. The first such meeting was held on December 11, 1957.

On the same day we held a meeting with other representatives of the Commission to discuss reprocessing. We hope to enter into negotiations with the Commission at an early date for a contract for reprocessing and related services.

We have had preliminary discussions with representatives of the Nuclear Energy Liability Insurance Association for the purpose of obtaining a rating on our plant as a first stage in the negotiation of an atomic insurance policy.

We have recently followed up these discussions by submitting a preliminary application for insurance.

Work at the site has now been resumed. Excavation of the nuclear portion of the plant will soon be completed and we expect to proceed shortly with the foundation work for the total plant.

I hope and believe that our major problems are now behind us and that we can proceed quickly and efficiently toward completion of our plant.

While we have concentrated on our own project, we are, of course, aware of the current discussion as to the advisability of an accelerated program of reactor construction within the United States.

During the past year two new factors have influenced this discussion, the high costs of reactor construction and the effect on world opinion of the accomplishments of the Russians in the development of satellites and missiles.

As applied to our domestic economy, we believe that our present national program for the development of atomic power is sound. Measured from the standpoint of our international prestige, however, it may not be enough.

If what we must have is a showcase for the world, some kind of governmental assistance will undoubtedly be necessary if the showcase is to contain all possible models and not just those which seem best for development for our own economy.

The two letters are attached to this statement, Mr. Chairman.

Chairman DURHAM. You would like these to be inserted in the record also.

Mr. FAIRMAN. Yes.

Chairman DURHAM. Without objection they may be inserted in the record.

(The letters referred to follow:)

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.,
New York, N. Y., August 29, 1957.

Gen. KENNETH E. FIELDS,
General Manager, Atomic Energy Commission,
Washington, D. C.

DEAR GENERAL FIELDS: As you know, Consolidated Edison is the holder of construction permit No. CPPR–1 and expects to construct and operate an atomic power reactor at Indian Point, N. Y.

Since Consolidated Edison is carrying on its program without Government financial assistance, no regular procedure has been established for the exchange of pertinent technological information developed on the one hand by Consolidated Edison and its contractors and on the other hand by or for the Commission. We believe it would be very useful if we could have regular meetings with the Commission reactor development staff to this end. It is the purpose of this letter to suggest that a schedule of such meetings be established at your convenience.

The proposed meetings, as we envision them, would have no connection with the submission of material and information to the Commission in the course of the exercise of its regulatory authority through the Division of Civilian Application. Such information and material would continue to be furnished and justified as required by the Commission's regulations, and the proposed meetings would not be considered by us as a substitute, either as to form or substance, for regulatory requirements.

We are willing to make a frank and complete disclosure of our entire program, including information outside of the Commission's boundaries of regulatory interest. Some of this information may be of value to the programs of the Commission and of others. We are confident that the Commission may similarly

be able to provide data on other research and development which will be of benefit to the speedy and effective conclusion of our program.

Very truly yours,

JAMES F. FAIRMAN,
Senior Vice President.

UNITED STATES ATOMIC ENERGY COMMISSION,
Washington, D. C.

Mr. J. F. FAIRMAN,
Senior Vice President,
Consolidated Edison Company of New York, Inc.,
New York, N. Y.

DEAR MR. FAIRMAN: I reply to your letter of August 29, 1957, to General Fields proposing a series of meetings between the AEC reactor development staff and Consolidated Edison and its contractors for the exchange of technical information pertinent to your nuclear powerplant.

We look upon this as an excellent suggestion and are proceeding to set up the first meeting at an early date.

We will be in contact with you and your staff from time to time in arranging the agenda of this meeting and would appreciate any suggestions concerning special points of interest to be covered which would be of value to your nuclear program. We would appreciate also an indication of possible dates for the meeting which would be convenient to you.

Sincerely yours,

W. KENNETH DAVIS,
Director, Division of Reactor Development.

Mr. FAIRMAN. With your permission I should like to make a few brief remarks in my capacity as chairman of the technical appraisal task force on nuclear power of the Electrical Institute. Would you prefer I proceed now?

Chairman DURHAM. Thank you very much, Mr. Fairman. Your project is entirely privately financed?

Mr. FAIRMAN. Yes, sir.

Chairman DURHAM. No Government participation whatever?

Mr. FAIRMAN. That is right.

Chairman DURHAM. I want to congratulate you on your program of informing the public. I believe that is the first instance that the committee has knowledge of such a program being initiated and carried out by private enterprise as far as I know.

Mr. FAIRMAN. We think it is quite vital, Mr. Chairman, to keep the people informed and gain their confidence.

Chairman DURHAM. One of our problems is educating the public and this is a means of doing it.

Mr. Holifield.

Representative HOLIFIELD. I have one comment. I notice in your letter you state:

> We are willing to make a frank and complete disclosure of our entire program, including information outside of the Commission's boundaries of regulatory interest. Some of this information may be of value to the programs of the Commission and of others.

I think that is a laudable action on your part in view of the fact that you are undertaking this great enterprise and also that you are willing to recognize that there is public interest and an exchange of information obtaining and offering to make the information available.

I commend you for that policy and also the fact that you are giving us these letters to put in the record.

Was your change of the type of fuel rods last year affected by the Commission's announcement of buyback on plutonium?

Mr. FAIRMAN. No, sir.

Representative HOLIFIELD. In other words, the changeover was not made on the basis of an economic return for plutonium?

Mr. FAIRMAN. No, not at all.

Representative HOSMER. What was the reason for the changeover in fuel rods and fuel elements?

Mr. FAIRMAN. It is quite a long story.

Representative HOSMER. Was it technical?

Mr. FAIRMAN. Yes, it had to do with the fact that metallic uranium—if your sheathing leaks a little bit you get some trouble with the water and you may get bulges and a failed fuel element.

The first thing that hit us was that factor, we had better use the ceramic fuels, oxides in pins. That makes a different kind of core.

The second thing that hit us was the zirconium water reaction. We debated whether we should go to stainless steel just in the interest of being sure that we would have something that worked and would give us less trouble.

We may be wrong. Anyway, we decided to go to stainless steel.

While all this was going on, you could not design the sphere to enclose this thing without knowing what it was you had to enclose.

Representative HOSMER. This is a little less experimental than the one you originally planned?

Mr. FAIRMAN. Yes, but we are still using the thorium-uranium combination that we started out with, only in a different form.

Representative HOLIFIELD. Your plant is not primarily a plutonium producer, is it?

Mr. FAIRMAN. No, sir.

Representative HOLIFIELD. As a matter of fact, there will be very little plutonium produced in this type of plant?

Mr. FAIRMAN. Relatively little. It will produce much more U–233. We hope sometime in the 2d or 3d or 15th stage of development to find a way of putting that stuff back in. That is a dream.

Representative HOLIFIELD. You would strongly advocate then a progressive program in fuel-rod research and development.

Mr. FAIRMAN. Absolutely.

Representative HOLIFIELD. You think that might be the key to economic development of cheap power?

Mr. FAIRMAN. It is a very large factor, sir.

In our case, as best as we can estimate at the present time, and we want it understood that they are guesstimates, it looks as if the capital costs and fuel costs are approximately equal.

You have to bring them both down. We think we will know how to bring the capital costs down after we have built one.

You will be able to cut some corners. The fuel cost is the thing that will require much more intensive effort and in our opinion in a field which is broadly applicable to all kinds of reactors, not just one particular type.

Representative HOLIFIELD. In your survey which you address yourself to, on the bottom of page 8, you say:

> If the buyback for plutonium is higher than uranium 233, it will react to the disadvantage of reactors which use thorium as fertile material.

That refers directly to your type of reactor, does it not?

Mr. FAIRMAN. It might include a job such as ours.

For example, if we had a high buyback price for plutonium and we were sure it was going to stick and the price of U–233 is as it is now, we would obviously change our core. We could not afford to continue to operate the thing in a more expensive way than otherwise would be available.

Representative HOLIFIELD. In other words, if longtime contracts are granted at $30 a gram for plutonium, it would have a direct bearing upon the type of reactors that you are building?

Mr. FAIRMAN. I think it would.

Representative HOLIFIELD. It would channel the science in that direction?

Mr. FAIRMAN. That is right.

Chairman DURHAM. Would you care to proceed now with your comments on the survey?

Mr. FAIRMAN. I am sorry; I don't have a nice summary statement, but I might call your attention to a few things and say a few words about it.

As you probably know, this task force reports to the board of directors of the institute. It was set up primarily for the purpose of advising the industry on the state of the reactor art and what things might be done, what things needed to be done.

It has been our attempt to summarize that as of the present time, recognizing full well, and that is why we call it an interim survey, that we may change our mind on many of these factors a year later.

It is a rapidly developing art. We thought that this report might be of interest to the Joint Committee and we offer it, therefore, for the record. We think it may be of interest to many other people and we have received from the board of directors a release so that we can publish it.

The probably means that we will simply make copies available to all who want them. Copies of the report have gone to the Atomic Energy Commission.

The mails being what they have been recently, I am not sure that they have got them yet, but they were sent.

I might call your attention to the last page, short of the two tables, where we set down what we call our conclusions. It is a rather generalized conclusion, but we think that is about all we can say at this time. That is on page 28.

The task force believes that there is a good probability of reducing the cost of nuclear power sufficiently in the next 10 years to make it competitive with power from fossil fuels in some parts of the United States.

The task force recommends further research and development along a variety of lines and construction of additional reactors ranging in size from experimental units to full-scale power producers as warranted by advances in the art. The task force bases its recommendations solely on technical considerations. Above all, the task force recognizes that this technology is fluid and reevaluation must be made periodically.

Chairman DURHAM. Without objection, the survey will be placed in the record, Mr. Fairman.

(The survey referred to follows:)

STATUS AND PROSPECTS OF NUCLEAR POWER—AN INTERIM SURVEY

A Report of the Technical Appraisal Task Force on Nuclear Power to the Board of Directors of the Edison Electric Institute, February 21, 1958

I. PURPOSE OF THE REPORT

This report is an objective review of the present status and the future prospects for the production of electric power from nuclear fuels. It attempts to present these data in such a way as to bring the broad aspects of the situation and its problems into clear perspective. It is intended to be of assistance to those engaged in or considering projects for the construction and operation of nuclear reactors for power production or for research and development in anticipation of such construction and operation. This report is specifically directed to utility executives. However, the members of the task force hope that the present report may also be of value to Government officials and private citizens concerned with establishing policy and program in this field. The material is presented in as nontechnical a manner as possible in the hope that it will be read by all who are interested and have a responsibility in the development of nuclear power.

This report, concerning a field which is expanding rapidly and in which both scientific discoveries and engineering developments may markedly alter the outlook, should not be construed as the last word on the subject. Rather, it is in the nature of a progress report intended to give the reader a grasp of the problems involved in developing commercial atomic power as they now appear. This report should be of help in making a choice among those types of reactors which appear today to hold the greatest promise of attaining competitive power costs. Areas of potential research and development to promote progress in the art also are described and their importance stressed.

II. ORGANIZATION AND ACTIVITIES OF THE TASK FORCE

On September 20, 1956, the Edison Electric Institute board of directors, acting on a recommendation of the EEI committee on atomic power, established the technical appraisal task force on nuclear power and set forth the following as its purposes:

1. To review continuously the progress of research and development work, in the United States and elsewhere, of importance to the achievement of competitive nuclear power.
2. To study and report on all power reactor programs and projects.
3. To study and appraise the technical and economic factors and the results to be achieved by the design and construction at different times of prototype or full-scale nuclear powerplants.
4. To act as a liaison group wtih the members of any nuclear reactor evaluation group that may be set up on a national level.

At that time the EEI board appointed the following electric utility company executives to the task force:

James F. Fairman, senior vice president, Consolidated Edison Co. of New York, Inc. (chairman)
James B. Black, chairman of the board, Pacific Gas & Electric Co.
Walker L. Cisler, president, the Detroit Edison Co.
Herbert J. Scholz, retired chairman of the board, Southern Services, Inc.
Philip Sporn, president, American Gas & Electric Co.
William Webster, executive vice president, New England Electric System

These original appointees were authorized to select as additional members of the task force outstanding engineers and scientists. The following individuals accepted appointments to the task force, and have served continuously since the task force was organized:

Robert F. Bacher, director, Norman Bridge Laboratory of Physics, California Institute of Technology
Marion W. Boyer, director, Standard Oil Co. (New Jersey)
Augustus B. Kinzel, vice president for research, Union Carbide Corp.
Henry D. Smyth, chairman, board of scientific and engineering research, Princeton University
Harry A. Winne, retired vice president, General Electric Co.

To assist in its endeavors, the task force has retained General Nuclear Engineering Corp., headed by Dr. W. H. Zinn, as consultant. It has also employed for special assignments the services of several other consulting organizations and individuals prominent in the nuclear field.

From the start task force members have considered their assignment a personal one, with designation of alternates permitted only in unusual circumstances.

From its formation in the fall of 1956 through the end of 1957 the task force held 20 meetings. Eleven of these were regular meetings scheduled at 4 or 5 week intervals, while the other 9, including an information exchange meeting with members of the Atomic Energy Commission staff and a meeting with Canadian scientists at Chalk River, Ontario, were called as the occasion required.

Initially the task force employed several consultants to prepare independent summaries of the status of power reactor development. Following receipt of these reports and analysis by an appointed subcommittee, the task force held a series of individual meetings with a number of reactor consultants as well as with several leading equipment manufacturers to obtain in some detail their respective views on nuclear power development. These discussions covered a broad area including various reactor types and concepts, major problems in the field, status of reactor technology, and promising areas of future development. During the several months' period over which these discussions were held the task force also met with members of the Atomic Energy Commission and their staff; with Dr. W. B. Lewis, vice president of Atomic Energy of Canada, Ltd.; and with Sir Claude Gibb, chairman of C. A. Parsons Co. and one of Great Britain's leading industrialists in the nuclear field.

Concurrently the task force, through appointed subcommittees, undertook studies of means of making economic analyses of nuclear powerplants, and of nuclear reactor parameters which should be considered in the technical and economic evaluation of nuclear reactors.

On completion of the initial phase of its activities in the fall of 1957 the task force began preparation of the technical report which is embodied in this document.

III. INCENTIVES FOR DEVELOPMENT OF NUCLEAR POWER IN THE UNITED STATES

Throughout its history the electric utility industry has continuously sought ways and means to reduce the price and improve the standards of its electric service. In the field of electric power generation, utilities, with their manufacturers and suppliers, have adapted every major fuel source for the production of electric power. As a result of continuing research and development over the years, technological advances in power generation have made a major contribution to the lowering of the price of electric service. One measure of these advances is the amount of fuel required to generate a kilowatt-hour of electricity. In 1907 it took the equivalent of 5.4 pounds of coal on the average to generate a kilowatt-hour of electricity. Preliminary reports indicate that in 1957 the average was 0.93 pounds and in the most efficient plants less than three-quarters of a pound was required. Major efforts on research and development of conventional generating facilities are continuing and indications are that still higher efficiencies in power generation from conventional fuels will be brought about.

Consistent with this tradition of progress in the development of every practical energy source for the production of electric power, the electric utilities have taken an active interest in nuclear energy from the time the existence of the nuclear chain reaction became generally known.

Unlike many of the world's industrial nations, the United States is blessed with abundant supplies of relatively low-cost fossil fuels, adequate to meet its needs for years to come. It is not confronted with the urgent need for nuclear energy that exists in many countries where even now substantial quantities of fossil fuels must be imported at high cost to meet current industrial demands, and where future industrial expansion will result in even greater fuel imports unless nuclear energy is able to take up part of this load.

With an entirely different economic situation in this regard, strong incentives nonetheless exist for the development of nuclear energy in the United States. While this Nation has large reserves of fossil fuels, particularly coal, these reserves are not inexhaustible. Demands for energy are expected to in-

crease greatly over the years, and it is apparent that a new source of energy will eventually be required to supplement that of fossil fuels in meeting the Nation's energy demands. Presently known and estimated reserves of nuclear fuels provide a great increase of the world's energy resources.

The time when the United States will actually need nuclear energy as a fuel depends on a number of variables, each in itself difficult to predict. These variables would include such factors as rate of increase in energy consumption, validity of estimates of fossil fuel reserves and need to conserve fossil fuels for important uses other than for generation of electric power. Recognizing, however, that nuclear energy will require many years of development before it becomes an economically competitive source of energy in the United States, it is important to proceed diligently with its advancement in order to have this new source of energy available before the need becomes critical.

Coupled with the eventual need for a new energy source is the probability that generating electricity with nuclear fuels may prove in time to be cheaper than generating it with fossil fuels in many parts of the country. If it is assumed that the most economically recoverable supplies of fossil fuels are being extracted at present, it is logical to expect that future fuel costs will trend upward as less economic reserves must be utilized, the rate of such upward trend being influenced by potential improvements in extraction technology. It would appear that possible increases in conventional fuel costs will result in nuclear power ultimately becoming economically competitive without so great a reduction in cost as would be required at present. Conceivable increases in conventional fuel costs and uses coupled with expected advancements in nuclear technology and economics will be principal determinants in the timing and extent of nuclear powerplant construction for the purpose of meeting the Nation's electric power demands. Areas of the United States where fossil fuel costs are highest will logically be the places where nuclear power will first become competitive.

The discussion in the above paragraphs has been limited by the task force to the possible needs for nuclear power in the United States. However, it is recognized that the policy and position of the United States Government with regard to other nations may have an effect on nuclear power development. This report is not an appropriate place to evaluate such considerations. The task force merely points out that other factors in addition to domestic needs may influence this country's attitude and expenditures on nuclear power development in the next decade.

IV. PRESENT STATUS OF THE TECHNOLOGY OF NUCLEAR POWER

As a result of its studies and deliberations, the task force has arrived at certain interim conclusions which are summarized in sections IV and V of the report. In section VI the task force suggests specific areas of research and development aimed at solving the technical and economic problems accompanying the development of competitive nuclear power.

A number of new rojects are included which, together with those already underway, give promise of achieving the goal of economic nuclear power. No attempt has been made to establish a precise time for carrying out such an effort since its determination involves such factors as national policy and research and development progress. However, the task force has indicated a period during which these projects could be undertaken, and has indicated the general order in which it believes they should be undertaken for optimum technological progress.

Although the first nuclear reactor was operated in 1942, the problem of releasing nuclear energy at high temperature to make possible its conversion to mechanical energy (at reasonable efficiency) did not receive much attention until the end of the war. The reason was that in a military sense the creation of the atomic bomb was overwhelmingly more important than any other use to which nuclear energy could be put. Soon after the war, many organizations began to study the problems involved in the use of the reactor for the generation of power. Some research and development work was done in the use of pressurized gas, sodium and pressurized water as coolants, all aimed at the generation of electricity. Breeder reactors received a great deal of attention for the obvious reasons that the availability and cost of enriched uranium were unknown, and the extent of the reserves of uranium was estimated at a very much lower figure than what is now the known reserve.

In 1948, the Atomic Energy Commission and the Navy together undertook the development of powerplants for submarines. This was the principal power

effort until the initiation of the AEC 5-year reactor development program early in 1954. The success of the submarine reactors, while it gave a convincing demonstration of the technical practicability of nuclear power, did very little toward demonstrating the economic feasibility.

The passage of the Atomic Energy Act of 1954 placed new emphasis on the generation of nuclear-fueled electricity for civilian purposes, and, at the same time, the availability and cost of nuclear fuels were announced and placed on at least a semirealistic basis. Since 1954, the economic question steadily has come into sharper focus so that at the present time it is accepted as the central problem of nuclear energy in the United States. Technically, reactors have consistently performed well, including operation at temperatures required for electricity generation. Costs have been another matter.

Though there are many difficulties and uncertainties which are pointed out in the following paragraphs of detailed comments, the task force is generally optimistic about the future prospects of the generation of electric power from nuclear fission, provided that the term "future" is appraised on a realistic time scale. The task force believes that it will be possible to develop, design, construct, and safely operate nuclear-electric powerplants which can compete economically with fossil-fuel-fired plants, but that the day of generally competitive nuclear power may be as much as 10 to 20 years away in this country. This time spread, of course, will be shorter in some areas of the country than in others, because the cost of fossil fuels has rather wide variation geographically.

The task force is not able to make a useful guess as to when thermonuclear energy may become economically competitive, nor, in fact, when it may become technically feasible. However, this probably is so far in the future that the electrical industry cannot afford to wait for it, but must go ahead with the development and construction of plants obtaining their energy from nuclear fission.

These brief introductory remarks outline the background for the following conclusions:

A. General comments

1. *Cost of nuclear power.*—No reactor is known which can be guaranteed to produce electrical power at any location in the United States at a cost equal to or less than the cost of power using conventional fuels. At certain locations in other countries, some of the reactors examined could very well be expected to produce power at no cost disadvantage. In these statements of cost, it is assumed that the buy-back credit for plutonium is $12 per gram.

2. *Improvements required.*—No one factor is responsible for the present high cost of nuclear power. In order to obtain competitive costs, reductions in the capital costs, fuel costs, and operating and maintenance costs are required. There has been too little experience to date to be sure of the situation with respect to operation and maintenance costs, but it is clear that the matter must receive careful attention from the prospective operators of nuclear stations if this item is to be held to reasonable values.

3. *Technical improvements.*—No reactor concept so far examined clearly promises technical improvements of a kind which are sure of accomplishment with a reasonable development effort, and which would necessarily thereafter bring about the cost reductions required. Most of the principal reactor types in some respects show promise of considerable improvement and, therefore, it is possible that several may, in time, reach the economic goal.

4. *Experience in design, construction, and operation.*—The task force recognizes that some improvement in the cost picture in all three areas mentioned will come about as a result of experience in constructing and operating nuclear plants. It is believed, however, that such experience alone will not be sufficient to cancel out the present cost disadvantage for nuclear power. Technical improvements as indicated above also are required.

It is evident that a second power reactor of any of the types currently under construction could be built at substantially lower cost than the first one. It is expected that operating experience with these reactors will demonstrate that they will have more power-producing capacity than that for which they were designed. However, the most optimistic estimates of these favorable trends do not result in capital costs per kilowatt competitive with plants using fossil fuels.

It is also true that fuel fabrication and reprocessing costs will be reduced with increased volume of production of fuel elements of the same kind.

These factors may lead to the strong temptation to build too many second generation plants of the same sizes and types. This should not be done, unless and until what is learned in work on the first generation of the plants, at what-

ever stage of their development, demonstrates enough to give promise that a second generation is likely to produce significant technological and economic improvement.

Premature concentration on a few concepts may well impede progress toward the goal of competitive nuclear power. It should be emphasized that the same funds devoted to basic research and development and to experimentation with less well developed concepts should result in more rapid progress toward that goal, if the concepts prove sounder.

5. *The price of plutonium and uranium 233.*—The buy-back price of plutonium and uranium 233 can, in the foreseeable future, have a considerable effect on the selection of reactor types and fuel cycles. For example, at a buy-back price of $30 per gram there would be no incentive for the development of reactors which could use plutonium when uranium 235 can be obtained at $17 per gram or less. At the $30 price, reactors producing plutonium and power can be anticipated in which the net fuel cost will be no more than 1 to 2 mills per kilowatt-hour, which compares favorably with conventional fuel costs anywhere. If the buy-back price for plutonium is higher than for uranium 233, it will act to the disadvantage of reactors which use thorium as fertile material.

6. *Government-established prices.*—At the present time, the economics of nuclear power cannot be free of an arbitrary factor, which is the price placed on various materials and processes by the United States Government. The price of enriched uranium established by the Federal Government is not a commercial price. The same statement applies to heavy water. It is doubtful that separation plants for either enriched uranium or heavy water could be established on a commercial basis and produce these important chemicals at their present prices. The reason is that it is unlikely that additional separations plants built just to meet the needs of the power industry would be established on as large scale as the present ones, or would have the advantage of the extremely low cost electric power for their operation now enjoyed by three existing separations establishments. In any event it is noted that concern about the availability of separated materials is apparently not immediate since the United States Government has shown no reluctance thus far in making adequate amounts available to the power industry at an apparently reasonable price.

Natural uranium is available to the power industry at a designated price. This sale price is not based on a free market situation but is determined by Government-guaranteed prices and Government contracts for milling.

The only costs available for chemical reprocessing are AEC estimates for capital and operating costs of a hypothetical plant.

These facts indicate that the nuclear power industry will be strongly affected by Government-established prices and their possible fluctuations, for basic materials and services. These fluctuations give rise to uncertainties which impede development of nuclear power. Every effort should be made to stablilize these prices for the maximum possible period of time. Natural uranium may be the first nuclear fuel material to achieve a normal commercial status. In that event, a reactor which is fueled with natural uranium and for which operation at sufficiently high burnup is possible to permit discard of fuel could be the first to achieve nuclear power based upon a truly free market.

7. *Safety of nuclear powerplants*—Steady improvement in the techniques for guaranteeing the safe containment of radioactive fission products of powerplants is noted. The stability of reactor systems is being studied continuously, and additional evidence of the inherent stability of power reactors is being obtained. The safety aspect of reactor technology is receiving first priority attention and, as a result, we believe it should be possible to establish that the power reactors now being developed will have proven safety characteristics. Consequently, the widespread use of reactors in the power industry is not expected to be limited by significant uncertainties about safety.

B. Specific technical comments

1. *Higher temperatures.*—Among improvements required, an increase in net thermal efficiency of nuclear plants is one of the most important items. This is desired not so much for its effect on fuel cost but rather for the associated implication for the reduction of capital costs per kilowatt which is implied. Higher working fluid temperatures, therefore, are necessary, which means that materials problems must have high priority in the development of power reactors.

2. *Fuel cycles.*—The fuel cycle plays a key role in the economics of nuclear power. The subject is complex and is not amenable to generalization because of the very substantial differences introduced by such matters as solid fuel versus

fluid fuel, central plant processing of irradiated fuel versus integrated processing, and Government-established buy-back prices for the several fissionable matters discharged from reactors. Some factors apply generally, such as the purchase price of enriched uranium or the use charge. For the solid-fuel reactors, the cost of fabrication, the cost of processing irradiated fuel elements, and the burnup or life in the reactor are items which are a substantial part of fuel cost and for which design and research and development can be expected to produce improvement. In the following paragraph, some specific aspects of fuel cycles are commented upon, but there is no intention of presenting a comprehensive discussion of the advantages and problems of particular fuel cycles.

(*a*) *Natural uranium.*—Natural uranium fuel for plants in the United States does not automatically lead to the lowest power cost. Although the basic fuel is the least costly, the effect of large inventories and the effect on the capital cost of the reactor must be taken into account. If the fuel fabrication costs for natural uranium are demonstrated to be significantly lower than those for enriched fuel, and if the specific power—that is, the megawatts of thermal power per ton of fuel—of the natural uranium fuel can be made comparable to the specific power for enriched fuels, then natural uranium would be superior. An important point is the fact that chemical processing may not be a necessary requirement for the natural-uranium reactor, although a high buy-back price for plutonium will, in practice, justify it.

The comparison between natural uranium and enriched uranium will largely depend upon the achievable burnup in the two cases. Because such burnup data are not yet available, especially the degree to which burnup is limited by reactivity, any conclusion on the relative economy of natural and enriched uranium must be deferred. Finally there are factors which make the natural-uranium-fuel reactor important for foreign installation.

(*b*) *Enriched fuel.*—The use of enriched uranium has permitted the engineering of reactors employing conventional materials of construction, such as stainless steel. There are distinct design and operation advantages in such construction, but the required higher concentrations of uranium 235 in the fuel demand quite long exposures exceeding an average of 10,000 MWD/ton (megawatt-days per ton) in order to obtain acceptable fuel costs. Again, no statistical information whatsoever is available on the life of such fuel. Until such information is available, the merit of the practice of overcoming nuclear-engineering difficulties by increasing enrichment must be left for future determination.

(*c*) *Recycle of fuel.*—Reactors whose fuel contains appreciable quantities of uranium 238 or thorium necessarily generate plutonium 239 or uranium 233. These isotopes are readily fissionable with thermal or fast neutrons and therefore as fuel are equivalent, in many respects, to naturally occurring uranium 235. Feeding plutonium 239 or uranium 233 into a reactor and thus replacing some uranium 235 which otherwise would be required is known as recycle of plutonium or uranium 233.

The desirability and importance of the recycle of fissionable material to reactors is a question which cannot be settled on technical grounds alone. There are technical problems to be solved in connection with the recycle of plutonium or uranium 233, but there is no obvious reason why these problems cannot be solved in a satisfactory manner. The recycle of plutonium, for instance, may be considered to be desirable in cases where enriched uranium is not available. In this case, the reactor would be one in which the feed is natural uranium, and plutonium is used to spike the reactor for the purpose of maintaining reactivity. The use of plutonium as a replacement for enriched uranium depends upon the price of plutonium and its relation to the price of uranium 235. The price of $12 per gram for plutonium is presumably based on its energy content relative to uranium 235 at $17.1 per gram making allowance for its nuclear and chemical properties. Because the fabrication costs for plutonium may be so much higher than the fabrication costs for uranium 235, the use of plutonium rather than uranium 235 based on the above prices could raise the cost of power. In the long term, therefore, it is conceivable that the fuel value of plutonium will be less than $12 per gram where uranium 235 is priced at $17.1 per gram. This conclusion does not apply to all reactors, since the fuel value of plutonium relative to uranium 235 is not the same for all reactors and some reactors do not include any fabrication in their fuel cycle. In particular, in a fast reactor, plutonium has superior nuclear properties. It can be concluded that the fast reactor can afford to pay a higher price for plutonium than can the thermal reactor.

(*d*) *Reducing fuel costs.*—Nuclear fuel costs must be brought to a point lower than the cost of fuel for conventional plants if the higher capital cost of the nuclear plant is to be offset. Three aspects of the nuclear fuel cost are of real concern.

First is the net burnup cost which is the difference between the value of the fuel which is loaded into the reactor and the value of the fuel which is discharged from the reactor. The net burnup cost depends on the cost of the enriched fuel started with, which increases with the degree of enrichment, and depends on the life of the fuel element in the reactor. Assuming the life of the fuel element is limited by metallurgical and chemical factors and not nuclear reactivity, every effort should be made to reduce enrichment as much as possible, thus reducing the net burnup cost for a given exposure of fuel. By no means, however, should the problem of maintaining reactivity in the course of achieving high burnup be minimized. A breeder reactor which generates the same fissionable isotope as the one which is introduced as fuel would, of course, have a negative net burnup cost. Because of this situation, the conclusion concerning the desirability of low enrichment does not apply to the breeder. The breeder situation is strongly affected by attainable breeding ratio and the cost of chemical reprocessing, and, hence, a generalization with respect to enrichment becomes meaningless at this time for a breeder.

The second point of concern is the fabrication cost, by which is meant operations such as forming UO_2 into pellets and encasing these in metallic jackets. At the present time, the cost of fabrication for enriched reactors is one of the largest components of the nuclear fuel cost and thus offers the best area for potential improvement.

The third point is the cost of converting UF_6 to a form suitable for fabrication. This is far from negligible, as it may amount to as much as 0.5 mills per kilowatt-hour. While the fuel element manufacturers are making a determined effort to reduce the fabrication cost, it is not clear that there is an equivalent effort in attempting to reduce the chemical conversion charges, both before reactor operation and at the time when separations plant product is to be converted for return to the diffusion plant. Such an effort is needed.

3. *Fluid fuels.*—It has long been recognized that a number of fuel problems which have an important bearing on the cost of nuclear power would be eliminated if the fuel were to be used in fluid form. Fabrication costs would be eliminated and perhaps discontamination costs greatly reduced. Maintenance of reactivity would be simplified due to the possibility of adding small increments of fissionable material. Elimination of radiation damage effects by the use of fluid fuel is expected to greatly ease the problem of obtaining adequately high burnup. Offsetting these clear advantages is the fact that fluid fuel systems introduce problems of corrosion and containment which are difficult of solution and which add to the complexity of the reactor system. The handling of the fuel, while much simplified, also requires the manipulation of fluid materials which are extremely radioactive. Until there is further experience with fluid fuels, it will not be possible to specifically estimate the extent to which they represent an overall improvement.

4. *Maintenance of radioactive systems.*—To date, no large-scale system anywhere has been operated in which the primary circuit working fluid or turbine feed is highly radioactive. Therefore, experience is lacking on the operational problems and the maintenance costs associated with such construction. Various quite attractive proposed power reactors have been examined which, in normal operation, circulate huge amounts of radioactivity in the primary circuit. Experience with operational and maintenance problems on a sizable scale is needed in order to form a judgment as to the economic feasibility of some of these attractive systems.

5. *Breeder reactors.*—The breeder reactor, in its ultimate concept, represents a broad approach to more complete and effective utilization of atomic energy rather than a simpler effort to produce electric power from atomic fuel. A plant of this kind could be independent of any Government facility. Such reactors probably will be used in completely integrated powerplants, meaning that the plants will have their own fuel element fabricating facilities, if solid elements are used, and their own fuel reprocessing facilities. Some of the important features of such plants are as follows:

(*a*) They would utilize low-cost depleted uranium, natural uranium, or thorium as fuel.

(*b*) They would utilize a very large part of the heat potentially available in the low-cost fertile materials, uranium 238 and thorium 232.

(*c*) They would produce the plutonium 239, or uranium 233, required as their own fuel, after the initial fuel charge.

(*d*) They would produce a substantial additional amount of plutonium or uranium 233 which can be used to provide the initial fuel charge of other reactors, or possibly to refuel thermal reactors.

If all, or even most, of these potentialities can be achieved, breeder reactors inevitably would become an important basic factor in the nuclear power industry.

There is no present evidence which indicates that capital or operating costs, less fuel costs, for the breeder will be materially different from similar costs for nonbreeder reactors. The fuel cost of the breeder will be strongly dependent upon reprocessing and fabrication costs, and, at present, these are undetermined.

The relative urgency for the development of breeder reactors can be judged only by examining the reserves of fissionable material and the rate at which these might be exhausted. The known reserve of uranium available at present prices is approximately 1 million tons. Prospects are considered favorable for the development of an additional million tons.

In order to estimate the amount of power which could be generated by nonbreeder reactors from this reserve, it would be necessary to discuss particular fuel cycles. In lieu of this, an approximation can be made by noting that the energy content of the uranium 235 in 1 ton of natural uranium is 5,000 MWD. Recycle of plutonium and reenrichment of discharged uranium may permit converter reactors to extract more energy from a ton of uranium than what is represented by the uranium 235 content. It is not easy, however, to obtain a yield which is greater than a factor of two over that of the equivalent of burning all of the uranium 235. At the rate of 5,000 MWD/ton (thermal) a reserve of 1 million tons permits the generation of 30 trillion kilowatt-hours of electricity. At present rates of power consumption, this would provide all of the world's electricity for a period of only 20 years. Some areas of the world are not well supplied with uranium, and in these the need to develop a more efficient use will arise much earlier than in those areas which have abundant supplies.

A successful demonstration of a breeder reactor would lend confidence that an electric-generating industry based on nuclear fission would be supplied with the necessary raw materials for centuries. The fast breeder is so dependent on fabrication of plutonium and uranium 233, and on decontamination of irradiated fuel, there is a strong incentive for developing cheap methods for such fabrication and decontamination. The economics of the fast breeder will depend directly on the success attained in these endeavors or in the success attained in eliminating the need for fabrication through the development of fluid fuel systems.

By careful design, it may be just possible to construct a thermal reactor with solid fuel elements which would operate with a net breeding gain. The attainment of a net breeding gain by itself is of little significance. The realization of a high conversion ratio is an advantage where high burnup must be obtained and where burnup is limited by reactivity loss rather than by radiation damage or corrosion. The thermal breeder of greatest importance, however, is a homogeneous reactor which can combine a very high specific power with a small net breeding gain, and thus produce an attractive rate of gain of fissionable material. In addition, integrated chemical processing and zero fabrication costs are inherent in the system, and should be effective in reducing fuel-connected costs.

6. *Ceramic fuel.*—Water-cooled reactors have brought about the specification of uranium oxide fuel because of the high chemical activity of uranium metal in hot water. Nonmetallic fuel materials also may have an important place in gas-cooled reactors and other high-temperature reactors, especially since their radiation damage resistance apparently is excellent. It is highly desirable in fixed fuel reactors to retain the fission products within the fuel. The problem of supplying a jacket impervious to fission products at high temperatures remains unsolved. The further development of nonmetallic fuels with jackets able to withstand high temperature without leaking fission products should be a fruitful line of effort.

7. *Gas cooling.*—As coolant for the fuel element which operates at high temperature and which does not leak fission products, pressurized gas has some advantages. Some chemically inert gases do not become radioactive in the reactor, and therefore permit the use of the simplest type of primary circuit construction. The principal disadvantage of gas is its relatively poor heat transfer capability. Any device which increases the working pressure of the

gas and therefore increases the mass heat transfer is important. The possibility of loading the gas with particulate matter in order to obtain high mass heat transfer without high gas pressure is of great interest.

8. *Pressure tube reactors.*—Both water and gas, to be used successfully in reactors, must be operated under pressure. For very large reactors, to confine this pressure in an enveloping vessel involves most difficult engineering and construction. The tube-type reactor which confines the temperature within a small tube largely eliminates the limitation in size which is inherent in the pressure vessel reactor. The development of a suitable pressure tube is a task of a high order of difficulty and importance. The tubes must withstand high pressure and must last a long time in the reactor. Once developed, however, the pressure tube will remove any limitation on the size of reactor imposed by a pressure vessel and also will avoid the problem critical in many cases of transporting a large, heavy object such as a pressure vessel.

V. COMMENTS ON RESEARCH AND DEVELOPMENT AND SPECIFIC REACTOR TYPES

A. General research and development

There are three types of research that enter into the technological developments leading up to the construction of nuclear powerplants. The first of these includes investigations in physics, metallurgy, and chemistry on which the whole technology is based. The second is concerned with reactor art in general and the third is concerned with specific types of reactors.

A reactor-development program should be based on a broad foundation of fundamental research. Much of this research should be supported for its own sake as a contribution to knowledge which may ultimately be useful. Information of use to reactor designers is likely to come from fundamental work in metallurgy and materials, from a further knowledge of the nuclear properties of various elements, and from a further understanding of such general subjects as radiation damage, corrosion, and the like.

The second area of research which should be pursued is aimed more directly at reactor technology. The need for research on fuel elements and on chemical processing has been mentioned. More work is also needed on reactor control both as to methods and materials to be used and as to procedures for evaluating effectiveness. Little has been done on the buildup of plutonium and higher isotopes in uranium cores at it affects reactor systems. These are but examples of some of the problems which should be solved. A thorough and systematic knowledge of this and other fundamentals should eventually enable a reactor designer to plan for a new reactor without recourse to costly and time-consuming critical experiments and in-pile irradiation programs.

Evidently research and development work in this general field of reactor development technology is of paramount importance. Ideas new to the reactor art may be developed and extensions in performance of existing reactor types may become possible as the result of such work. Its extent at the present time is very great. Most of this work is being carried out under the auspices of the Atomic Energy Commission. This program should be continued in a vigorous manner and, where a promising lead opens up, should be expanded.

Recorded here are further specific items of research which ought to be instituted or expanded. In this listing, no attempt is made to record all subjects which show promise, but only those which have come to particular notice through discussions held by the task force. The order of listing is not intended to imply order of importance.

1. Further development of high-temperature fuel materials, especially nonmetallic materials having properties acceptable to industrial power reactors.

2. Every effort should be made to develop fuel materials suitable for use in power reactors and which can be exposed to very high burnup. To be suitable in power reactors, these fuel materials must not contain quantities of neutron-absorbing diluents.

3. Corrosion studies, especially of materials which can be used in high-temperature water systems and which promise reduced costs for fuel element preparation. Also, the corrosion of materials suitable for use in fluid fuel type reactors. Especially important is the determination of the effect of intense nuclear radiation on the corrosion resistance of reactor materials.

4. The programing of shifting fuel in a reactor and the programing of the control rod system in order to maintain adequate reactivity in high burnup reactors is a matter of some difficulty and concern. Alleviating this difficulty

by any technique, such as the variation of concentration of light and heavy water in the moderator, might have important consequences.

5. The majority of the nuclear powerplants now being planned or constructed will consume only between 0.5 and 1 percent of the uranium in the metal as mined. At this low utilization, the uranium 235 supplied by nature does not constitute a large addition to the energy resource in foossil fuels. In order to achieve a greater utilization of uranium, it will be necessary to recycle plutonium or uranium 233 to reactors. The basic problem is the same whether the reactors are breeder reactors or nonbreeder reactors in which the recycle merely raises the utilization to a percentage several times of what can be done without recycling. Materials containing plutonium which are resistant to radiation damage for high burnups must be developed, and inexpensive methods of fabricating fuel elements in the presence of the high alpha radioactivity of plutonium or uranium 233 must be evolved. The recycle of these fissionable isotopes to the powerplants will materially reduce the reliance upon separated uranium 235 from gaseous diffusion plants. In foreign countries where access to separated uranium 235 may be limited, the recycle of fissionable material can be very effective in easing the problem of supply of separated fissionable material. Availability of breeder reactors would reduce the problem of new fissionable material to one of an adequate supply of natural uranium, thorium, or even depleted uranium. In view of the potential advantages of recycle, the necessary research work to bring it about at an acceptable cost should be given high priority.

B. Specific reactor types

The development and construction of nuclear powerplants cannot be discussed without reference to the rating or the size of the reactor. The rating for a well-developed type for which there has been previous construction and operation experiencec should be 100 eMW or more, in which case the reactor powerplant may be termed full scale. Where there has not been much previous experience, there is strong incentive to plan a reactor of smaller size in order to cut the magnitude of any possible operating loss. There has been some confusion concerning the use of the terms "full scale," "prototype," and "reactor experiment." In this report, these terms have the following meanings.

A reactor experiment makes no attempt to incorporate features which would be a necessary part of any full-scale reactor. Reactor experiments have, as their purpose, the testing of an idea or a unique piece of equipment. As a matter of fact, a reactor experiment is just one phase of the research and development program, and should be considered as such. The size is immaterial, but, generally, reactor experiments will be small with generation capability of less than 10 megawatts. Indeed, the actual generation of electricity is unnecessary unless it is a vital part of the experiment.

A prototype reactor powerplant contains all the basic features of the full-scale plant, but is normally thought of as considerably smaller than full scale. A test as to whether or not the reactor is a true prototype is to ask if it can be scaled up without facing new basic or engineering problems. The size of the prototype reactor will be somewhat dependent upon type. For example, heavy water-moderated prototype reactors are inherently large when compared with light water-moderated prototypes. A prototype heavy water-moderated reactor should be rated at no less than 50 eMW, whereas quite satisfactory light water-moderated prototypes might be achieved at one-tenth this size. In general, a prototype reactor should be designed to conform with the preliminary design of the corresponding full-scale reactor. This is to be sure that there is not a serious difficulty in the design for the full-scale plant which may not have been encountered in the design of the prototype.

A full-scale reactor plant is one in which the electrical rating is equivalent to the rating of the conventional unit which otherwise would be installed. Generally speaking, in the United States full-scale nuclear powerplants would employ units having a rating of more than 100 eMW, with 200 eMW as the minimum size unit for many installations.

1. *Reactor experiments.*—A number of reactor experiments are under way and others are planned. The ones named here will be observed with great interest since each contains a feature which, if proved to be practical, could be quite decisive in the future achievement of economic nuclear power.

(*a*) *Liquid metal-fueled and fused salt-fueled reactors.*—These reactors are preeminent in combining very high-temperature operation and very high burnup of fuel. Liquid metal-fueled reactors of a number of types are under design.

Reactor experiments for these types, at the appropriate time, are a necessary step in their evaluation for possible future use. The high cost of fabricating nuclear-fuel elements and the difficulties of obtaining high burnup continue to indicate that liquid fuels may be of basic importance.

(*b*) *Intermediate energy reactor.*—The sodium-cooled, graphite-moderated reactor can provide steam of excellent quality. The nuclear performance of the reactor suffers because of the necessity of using canning material for graphite and tubes to conduct the sodium. Raising the energy of the neutrons gives the opportunity of removing some of the disadvantages of the structural material in the core, while permitting these structural materials to be conventional. The SIR submarine reactor is of this type. As a breeder reactor, the intermediate neutron-energy machine when fueled with uranium 233 may have advantages, especially in size (it will have a larger core), with respect to the fast neutron breeder reactor. The development of this type would be of continuing interest.

(*c*) *Sodium-cooled, D_2O-moderated reactor.*—The sodium-cooled, deuterium-moderated reactor is one of the few which could operate on natural uranium and which could produce high-temperature steam. A demonstration of its safety and reliability through a reactor experiment is planned and will be of great interest.

(*d*) *Steam-cooled reactor.*—A reactor in which the steam acts as the coolant is an extension of the boiling reactor with nuclear superheat, or may be looked upon as another version of the gas-cooled reactor. Since so much of electric utility experience is with superheated steam, it is apparent that an effort to produce such steam in a reactor would enable the most direct application of that experience. Of special appeal is the steam-cooled reactor in which the superheated steam from the reactor is fed directly to the turbine. The simplicity of this cycle is attractive, and a design effort to ascertain practicality is warranted.

2. *Prototype reactors.*—In general, prototype reactors must pass through three phases: research and development, design, and construction. All of the proposed prototype reactors have problems which must be solved in the development stage. During the design, features may be uncovered which make construction of the reactor unrealistic. Consideration of the following reactors is warranted, with the understanding that the development or the design would be abandoned at any time that the project appears to be leading to a reactor which, either technically or economically, fails to show promise. As previously noted, before construction of a prototype, a preliminary design of a full-scale unit should be carried through.

(*a*) *Aqueous homogeneous reactor.*—A preliminary design for a full-scale aqueous homogeneous reactor has been made. It would appear that some vexatious technical problems still remain to be solved if the reactor is to have the most advanced performance. Operational experience on a large-scale plant is badly needed in order that questions of maintenance can be determined. A full-scale design effort and the construction of at least a prototype is warranted if the design indicates a workable plant.

(*b*) *High-temperature, gas-cooled reactor.*—A reactor in which the coolant is a pressurized gas and the moderator is D_2O has been proposed. This reactor uses pressure tubes. The temperature of the gas produced by the reactor is to be high, at least 1,000° F., but the gas must not contain fission products. This is an advanced type of gas-cooled reactor and, if successfully developed, promises to reduce capital and fuel costs. The reactor differs from the graphite-moderated, gas-cooled machine in that pressure tubes rather than a pressure vessel are used. The high temperature of the gas indicates that the fuel must be ceramic material encased in impervious jackets. With D_2O as moderator, the possibility exists of achieving a reactor which can be fueled with natural, or very slightly enriched, uranium. A vigorous program for the development of this reactor type is justified.

(*c*) *Organic cooled and moderated reactor.*—The organic-cooled and moderated reactor now exists as a reactor experiment. If the experiment yields results which are favorable, it would appear to be a feasible matter to design a prototype reactor and to arrange for its operation as a powerplant. Long-term operational experience would seem to be essential for this reactor, and for this purpose the prototype construction is desirable if the decomposition problem is indicated to be adequately under control.

(*d*) *Boiling water reactor with nuclear superheat.*—The water reactors all suffer from the fact that the steam available to the turbine is saturated. In some cases, this situation has been improved by adding superheat generated by fossil fuel. A boiling H_2O reactor in which the steam formed in the reactor is superheated in appropriately placed channels in the reactor would be a distinct improvement. Consideration of this or any other scheme which will add nuclear superheat to the water reactors is warranted and urged. Construction of either a prototype or reactor experiment is indicated, depending on the scheme for producing nuclear superheat.

(*e*) *Slurry reactor.*—Some of the difficulties encountered in the development of the aqueous homogeneous reactor can be circumvented by the use of an oxide slurry of fissionable material in water. However, this brings with it other problems and other difficulties. A sizable amount of research and development work on such a reactor has been accomplished. This research and development effort should be continued and a definitive design of a prototype slurry reactor powerplant should be produced. Construction of a prototype is to be contingent on the promise of the design for economic success and the successful conclusion of correlative experiments.

3. *Full-scale reactors.*—(*a*) *Pressurized water and boiling-water reactors.*—The pressurized water and the boiling water-cooled and water-moderated reactors are furthest developed in the United States. It is expected that in the future progress of these reactors, the trend toward similarity in performance will continue. In pressurized water reactors, local boiling will be introduced, and for boiling-water reactors, there will be further use of the forced circulation of water through the core. Additional operating experience will make the evaluation of these types a much more certain matter. There are sizable cost reductions possible for these reactors, both in capital costs and in fuel costs. A continuing program of the construction of improved types of such reactors would give experience which may result in reduced costs. This statement should be qualified, however, by the observations which have been made in part 4 of the general comments. A major requirement for the reduction of fuel costs is to obtain volume for fuel element manufacturing and processing. In the absence of such volume, fuel costs are not likely to be reduced to the low values which nuclear energy promises and requires. The fact that the fuel fabrication costs in the cases where volume exists (United Kingdom and United States plutonium production) are, in fact, low, supports this opinion and gives hope that a similar situation will be brought about for power reactors. It is expected that enriched uranium water reactors which are erected in foreign countries will augment the fuel element production volume. Cost cutting for the enriched uranium, water reactors, through further construction either abroad or at home, is a necessary requirement for the determination of utmost possibilities for obtaining competitive nuclear power with this type of reactor. The design and construction of a limited number of additional reactors of these types seems therefore desirable, but only if analysis indicates substantial cost reductions in capital and fuel costs are possible. Preferably, each should incorporate new features or new design parameters.

Present water-cooled reactors apparently are limited to a coolant exit temperature of approximately 600° F. Both pressure and corrosion problems become formidable if an attempt is made to increase temperature beyond this limit. The fact that water-cooled machines are so limited raises some question about the long-term position of such reactors. If non-water-cooled reactors are developed to a point where their performance otherwise is equivalent to that of water reactors, it can be expected that the water reactors will give way to ones of basically higher temperatures.

(*b*) *Very large-scale reactors.*—The generation of very large blocks of nuclear power in a single reactor is recognized as a way of reducing power costs. The construction of such a powerplant would require very large capital investment, and therefore can only be done for a reactor system of proven reliability. The Hanford and Savannah River reactors in the United States are proven types. Either one apparently can be designed in a pressurized version. Either one could be constructed to yield 200 or more eMW in a single reactor powerplant. Development work is required in both cases, but it is felt that the result of such work would leave no doubt as to the feasibility of the plants. The pressurized water, graphite-moderated reactor would use slightly enriched fuel. The pressurized D_2O reactor could operate on natural uranium. It is believed that a power version of either machine could be a demonstration of large-scale

nuclear power and plutonium production. An engineering design and analysis would permit a decision as to the desirability of constructing such a reactor.

(*c*) *Sodium-cooled thermal reactors.*—Sodium as a coolant remains one of the most attractive ways of achieving higher cycle efficiency through high temperature. The success of the sodium-cooled reactor will depend greatly upon the details of engineering, since the radioactivity of the coolant is expected to require relatively high capital cost. The production of another design version of the sodium-cooled, graphite-moderated reactor could be expected to realize further significant improvements with respect to capital cost.

(*d*) *Gas-cooled, graphite-moderated reactor.*—High-presusre, high-temperature gas as a working fluid deserves consideration as leading to higher efficiency which, as has been pointed out, is very desirable. Gas cooling and graphite moderation have been developed in the United Kingdom for large-scale plants. The capital cost is high, mainly because of the large physical size of the installation. An attractive feature of the plants is the fact that the materials of construction generally are ordinary steel. Fuel costs are low because of the use of natural uranium and the low fuel fabrication cost. Present estimates indicate that this reactor type, because of its high capital cost, will have great difficulty in becoming economically competitive in the United States. Such a design has been undertaken to see if it is possible to come up with an arrangement which would sufficiently improve the economics.

(*e*) *D_2O-cooled, D_2O-moderated reactor.*—The heavy water-moderated, heavy water-cooled reactor with pressure-tube design is very similar to the pressurized D_2O tank-type reactor. It also can be operated on natural uranium. Feasibility depends upon development of a suitable pressure tube. In this respect, it is dependent upon the solution of the same developmental problem as the pressurized water, graphite-moderated reactor mentioned in paragraph *b* above. Construction on a large scale should not be undertaken unless design and analysis indicate a favorable cost picture.

4. *Breeders.*—The general subject of breeders has been discussed in section IV, B (4) discussed on page 13 at considerable length. The two projects now underway, a full size fast breeder under construction near Monroe, Mich., and a smaller experimental unit at the ARCO reactor test station should furnish substantial amounts of information on the potentiality of plutonium breeding. Also the homogeneous reactor discussed above on page 21 will give information on breeding uranium-233 from thorium. Because these projects will continue for several years we have included no fast breeder either in the above list or in the new projects suggested in section VI.

VI. SUGGESTIONS FOR REACTOR CONSTRUCTION

This section of the task force report reviews the measures required to answer the type of question raised in the preceding section.

The task force assigns the highest priority to the vigorous continuation of general research and development in relevant fields of science and in nuclear power technology. The task force further believes it essential to construct and operate experimental reactors, prototype reactors, and full-scale power-producing reactors. A number of such reactors have been constructed. Others are under construction, authorized, or under serious consideration. Accompanying table I lists those projects which are underway or proposed at present, but excludes those reactors already operating.

A review of the present state of the art such as is given in section V suggests a number of reactor projects that should be added to those completed, underway, or proposed. Reactor projects in preliminary stages of investigation, or ones not yet being undertaken are listed in table II.

The reactor projects listed in table II are given in a rough order of priority with a time interval during which it is estimated the project could be undertaken and completed. Second-generation reactors are scheduled in such a way that operating experience in the first-generation reactor can be applied to the design of the second.

In each project, research, development, and preliminary design are expected to precede a decision to construct. In the early days of power-reactor development there may have been justification for choosing a reactor type and driving through to construction without setting up in an orderly manner points in which the future potential of the scheme is analyzed. Although any program of construction carries with it some degree of urgency it is not of such order as to warrant displacing an orderly approach, especially where reactors

are second generation or variations of proven types. Careful analysis of preliminary designs and a review of cost estimates are necessary if the building of the reactors is to make progress toward the goal of achieving economic power.

Not all of the reactors listed should be expected to be carried to the construction stage. Willingness to postpone construction indefinitely if research or design studies are highly unfavorable is a necessary part of such effort. The decision to include a particular type will hasten the day when it can be eliminated from further consideration if the preliminary work shows that it fails to measure up. It would be surprising if more than a few of the types now listed remain attractive for economic power production after the development and construction has been accomplished. The period from 10 to 20 years hence should see a concentration on those few types which, by that time, have shown the best performance, both technically and economically. If these types, as they are developed, come up to expectations, they should come into extensive use by the electric power industry in the United States.

Nothing is suggested about the location of the reactors. Obviously the large units where operating data are desired over a period of years would be run at a minimum loss if they were located in high fuel cost areas. The total operating loss can be minimized by reducing the number of years during which the reactor must be operated. Reactors which continue to operate at a loss should be shut down as soon as all useful information has been gathered from their operation. Because of high fuel costs foreign countries may be considered for the construction of some reactors but it is clear that such locations are more appropriate for the more highly developed reactor types.

The dates given in the table are determined entirely by technical considerations. Time is allowed for the evaluation of data of previously constructed reactors or reactor experiments for a certain amount of research and development and for careful design studies with cost estimates. Naturally the amount of time required for these stages is a matter of judgment even when limited to technical considerations.

It would be possible to speed up the pace somewhat at the risk of considerable wastage of money and effort. Perhaps the goal of economic power might also be reached more rapidly by multiplying the number of reactors built in the period under consideration. This would also cost more. Possibly the total expenditure could be reduced if the effort were stretched out, but this is doubtful. It will be noted that the dates given in the table assume completion of the reactors listed in about 10 years.

VII. CONCLUSION

The task force believes that there is a good probability of reducing the cost of nuclear power sufficiently in the next 10 years to make it competitive with power from fossil fuels in some parts of the United States. The task force believes that it is not possible to identify the type of reactor which is most likely to be successful. The task force recommends further research and development along a variety of lines and construction of additional reactors ranging in size from experimental units to full scale power producers as warranted by advances in the art. The task force bases its recommendations solely on technical considerations. Above all, the task force recognizes that this technology is fluid and reevaluation must be made periodically.

TABLE I.—*Status of power reactors underway or proposed* [1]

Project	Approximate electrical rating (megawatt)	Status	Approximate completion date
Boiling water, enriched uranium fuel.	180	Under construction by Commonwealth Edison Co.	1960
Pressurized water, enriched uranium fuel.	275	Under construction by Consolidated Edison Company of New York, Inc.	1960
Do	134	Under construction by Yankee Atomic Electric Co.	1960
Boiling water, enriched uranium fuel.	22	Proposed by Elk River Electric Cooperative Association. AEC in process of selecting contractor.	1960
Do	66	Northern States Power Co. and associates. Proposal under 3d round accepted by AEC.	1962
Sodium cooled, fast breeder	100	Under construction by Power Reactor Development Co.	1960
Do	20	Under construction by Argonne National Laboratory.	1960
Sodium cooled, graphite moderated	75	Contract for construction between AEC and Consumers Public Power District of Nebraska.	1961
Sodium cooled, D_2O moderated	10	Proposed by Chugach Electric Association and Nuclear Development Corporation of America. AEC has authorized some research and development.	1962
Organic cooled, organic moderated	12.5	Proposed by city of Piqua, Ohio. Contract under negotiation between AEC and Piqua.	1961
Liquid metal-fueled reactor experiment.	[2] 20	Contract between AEC and Babcock & Wilcox Co., and Brookhaven National Laborarory.	1959
Aqueous slurry	70–150	Pennsylvania Power & Light Co., Baltimore Gas & Electric Co., and Westinghouse Electric Corp. Proposal to AEC under 3d round.	1963
D_2O cooled, D_2O moderated, pressure tube.	17	Carolinas-Virginia Nuclear Power association, Inc. Proposal to AEC under 3d round.	1962
High temperature, gas cooled, D_2O moderated, pressure tube.	50	East Central Nuclear Group and Florida West Coast Nuclear Group. Proposal to AEC.	1963
Boiling water, enriched uranium fuel.	60	Announced February 1958 by Pacific Gas & Electric Co.	1962

[1] Reactors in operation as of January 1958 omitted.
[2] Heat.

TABLE II.—*Type and size of power reactors for new undertakings*

Project	Approximate electrical rating (megawatts)	Status	Approximate time interval for project
Boiling water with nuclear superheat.	10–50		1958–62
Gas cooled, graphite moderated	50	Under study by contract with AEC	1959–63
Aqueous homogeneous solution	75–150	do	1959–64
Fused salt fueled	10		1959–64
Steam cooled, D_2O moderated	10		1959–65
Intermediate energy neutron breeder.	10	Under study by Southwest Atomic Energy Associates.	1958–67
Pressurized water, enriched uranium fuel.	200		1959–65
Boiling water, enriched uranium fuel.	200		1960–66
H_2O cooled, graphite moderated, Hanford type.	250		1959–66
D_2O cooled, D_2O moderated, Savannah River type, natural uranium.	250		1960–67
Sodium cooled, graphite moderated	200		1961–67

NOTE.—The task force believes these types warrant consideration for new undertakings but that construction of any reactor should be undertaken only after thorough investigation, including necessary research and design which clearly indicates that carrying the project through to construction and operation will result in power costs approximating those obtainable from conventional plants in location under consideration. See discussion on pp. 26 and 27.

Mr. FAIRMAN. I shall be happy to answer any questions on it at a later time, by correspondence or come down and visit with you, if you so desire.

Chairman DURHAM. Do you have any target date for completion?

Mr. FAIRMAN. Yes, our original application for construction permit set the dates of December 1, 1959, to December 1, 1960.

Now it is going to be a tight squeeze to get within that. A lot of things can happen, but we still hope we will get it ready and critical by the end of 1960.

Chairman DURHAM. Thank you very much, Mr. Fairman.

Mr. Holifield has a question.

Representative HOLIFIELD. Would you care to commit yourself, Mr. Fairman, or to give this committee the benefit of your thinking on the policy of the Government committing itself for a long-time period on the purchase of plutonium of U–233?

Mr. FAIRMAN. Mr. Chairman. I think I could say I agree pretty much with Mr. McCune, if I heard him and understood him correctly.

I think we should try to be realistic about the value or the cost of these things as rapidly as possible so that we are not led down one street which is the wrong street it turns out a few years later.

It would be a great waste, it seems to me, to build reactors of types which depended on a given relatively high price of any one of these things, or on the other hand, depended on a relatively low price.

Representative HOLIFIELD. In other words, it would place the industry on a false basis if we signed rigid contracts which would establish an arbitrary price without any real knowledge of what the future needs might be for fuel or for weapons?

Mr. FAIRMAN. That is right.

It would be helpful, however, one must admit, to anyone contemplating going into any one of these things, if he had some confidence that the fluctuation was not going to be too wide over a reasonable period of years.

Representative HOLIFIELD. I agree with that. My thought, however, is that this is such a rapidly changing industry that long-time contracts tend to become obsolete and even questionable.

We are going through that period now on even our 7-year prices for uranium ore, for the raw material.

We find ourselves bound by contracts with foreign nations to the detriment of our own economy here at home.

We are having to curtail development in the Colorado Plateau areas because of the rapid development of ore there, No. 1, and also because we have the biggest contracts for a long period of time with Canada today and Belgium, and we have to and should honor our contractual obligations with foreign nations.

But in order to do that we are having to pinch down at home on our own people, and we are throwing people out of work there.

This is just one indication of the danger of a long-term contract.

Now I supported the 7-year contracts so I am not kicking somebody else around. I still think it was justified because at that time we did need a tremendous development in the field of uranium ore production.

I think it was all right, but now we find the situation changing. I am somewhat doubtful about tying up the Government so far into the future on any rigid basis.

Mr. FAIRMAN. The only justification for it would be if it is deemed by the Congress to be necessary to do a lot of things more quickly than would ordinarily happen. That might justify it. That is part of the price you pay to get what I call facetiously the showcase.

I think I can answer your question by two things which we did, as expressing our own views.

We were well launched on this concept and work was being done on design when I got a discreet inquiry from the Commission as to whether or not if the price of thorium was increased it would change our whole mind.

I said how much and what is the reason? The reason was that by stating a higher price it would enable independent producers to get into the market.

I said, "That is fine. If you are sure that this price that you are now establishing will encourage other people outside of the Government agencies to make thorium in a form we can use, I am all for it. Are you sure that this will do it?"

They said "Yes." We have been able to get quotations on thorium oxide. Well, it raised our fuel cost, but it is a step in the right direction, and we felt we were not being kidded by something that might happen later.

The second thing is that I have been working on my friends, in the chemical industry, for about 4 years. My theme song has been "I wish you fellows would get into the business of this reprocessing and we are perfectly willing to pay you more than we are going to have to pay the Commission if you get into it.

"We want to get this thing freed up so that we know what the commercial prices are."

So far no one of them has been able to see his way clear, but when their services are available we will use them.

Representative HOLIFIELD. I agree with you. I think your position is logical and we will begin to find out what the real costs are in this industry and not kid ourselves.

If it takes a subsidy in the right kind of way to get the thing off the ground, let us admit it and do it, but let us not try to hide it; that is my point of view.

Let us be honest with the American taxpayers.

Mr. FAIRMAN. That is right.

Representative HOLIFIELD. And I think you are being in your company's operation.

Mr. FAIRMAN. We are trying to be, sir.

Chairman DURHAM. I think the Commission also last year asked for a bid on thorium as you recall, and we did not get it.

Mr. FAIRMAN. They could not get anybody to do it.

Chairman DURHAM. Thank you, Mr. Fairman.

Mr. FAIRMAN. Thank you.

The next witness is Mr. Robert A. Gilbert, Intercontinental Research & Analysis Co.

STATEMENT OF ROBERT A. GILBERT, INTERCONTINENTAL RESEARCH & ANALYSIS CO., NEW YORK CITY

Mr. GILBERT. Thank you, Mr. Chairman.

Chairman DURHAM. You may proceed.

Mr. GILBERT. My name is Robert A. Gilbert, and I am the owner of an economic and statistical research company called Intercontinental Research & Analysis Co., of 19 Rector Street, New York City.

Before I proceed with my statement, I wonder if you gentlemen would have any interest in what comment I might offer on the situation in England.

I am making this statement because I spent about 2 months abroad this summer in a manner indicated in the first paragraph of my statement, and I am somewhat familiar with the situation in England.

I saw the chairman of the board and president of 24 of the leading electrical manufacturers over there who are involved in this program and various other prominent people in England.

Chairman DURHAM. We shall be glad to have your comment.

Mr. GILBERT. Shall I comment now, or after my statement?

Chairman DURHAM. As you prefer.

Mr. GILBERT. As I recall, the question was whether or not there was a Government company in England that was engaged in the production of reactors. This is simply not so.

The British Government has a socialized arrangement in the production of electricity and its own AEC in the research and production of experimental reactors, but in the building of large-scale plants contracts are let privately to five competing groups and these groups are not subsidized in any way. They have to bid against each other, just as people bid for Government contracts here.

Chairman DURHAM. They select the bidders?

Mr. GILBERT. Yes, the bidders make a concealed bid and the lowest cost bidder gets the contract. They do not all bid for the same kind of plant, either. There are various technical differences.

So it is highly competitive, although the British Government has allowed certain groupings of companies with similar interests. They will let a manufacturer of dynamos tie itself up with a particular boilermaker and a particular maker of switch gear to form what they call a group. That particular group will bid against another group.

There are 5 or 6 large groups in England at the present time, but they are not being subsidized. In fact, some of those I talked with were afraid they were not geting enough out of the business, and I think to some extent that is true.

So the situation is a little bit different than was outlined in that respect before.

And involved there is also a question, I think, of the solvency of the currency of one of our greatest allies. We do not perhaps want to put ourselves in the position of trying to destroy a fine new product that they have on which they expect to depend, to earn foreign exchange.

So I think that a very broad point of view should prevail on this question and my entire statements is hinged on that consideration.

If I may I will proceed with my statement.

Representative HOLIFIELD. Before you proceed, you pointed this out much clearer than I did in my questioning of Mr. McCune. I

mentioned in my remarks that the English Government dealt at arm's length with these companies and actually charged them royalties on Government-owned patents.

Mr. GILBERT. That is right.

Representative HOLIFIELD. So if I understood Mr. McCune right—I do not know whether he is in the room or not, I do not want to put words in his mouth—his remarks seemed to indicate to me that the American manufacturer here was actually in competition with the English Government.

While there is assistance from the English Government in the buying of plutonium and the guaranteeing of fuel prices, it certainly is not a monolythic structure such as the Soviet Union has, if I understand it correctly, and I think your remarks have brought out the point much clearer than my questioning did.

Mr. GILBERT. It is a highly competitive situation.

Of course, I got the point of view of quite a number of competitors and each of the major electrical companies over there is striving night and day to beat the other out, right within England as well as abroad.

Representative HOLIFIELD. My strong feeling has been that if this program is based on an international urgency it is on an urgency of competition with the Soviet Union and not on the urgency of competition with the English.

The whole question of English economy and its relation to the free world enters into this.

If we are going to spend our time slaughtering the English just in order to obtain a trade advantage, we are going to have to make it up some other way in stabilizing their currency or foreign aid, or some other type.

So I think this is what has drawn me to the conclusion that we should be working with the English on a two-partnership basis in the development of cheap atomic electricity and recognize that the Soviet Union is our competitor and not the English.

Mr. GILBERT. I hope we do not slaughter the pound because nothing would make the English madder.

Representative HOLIFIELD. Slaughter what?

Mr. GILBERT. The pound sterling. They are tremendously proud of this new product and if they find we are going to subsidize the competition with them it will certainly cause a great deal of hard feeling in international relations. They have emphasized this product throughout the world now and they are tending to rely on it for increased exports in the next few years.

Representative HOLIFIELD. They have two pressures on them that we do not have. One is the pressure for electricity from the atom because of their dwindling fuel supply, and precariousness of their oil supply.

The second one is because of their desperate position as an exporting nation in comparison to ourselves; their reliance, in other words, upon export business.

I think those two factors should be taken into consideration, as you state, in the building of any kind of a subsidized export program in the United States which would in effect cut them out of the markets they need much worse than we need.

Mr. GILBERT. Yes, indeed. I think you are very sound, sir.

Chairman DURHAM. You may proceed with your statement, Mr. Gilbert.

Mr. GILBERT. Thank you, Mr. Chairman.

Mr. Chairman, my company has been retained on several occasions to do extensive studies on foreign investments for some of the largest professional investors, such as investment trusts, banks, brokers.

Last summer on behalf of these clients I went abroad, jointly with Dr. Alexander Sachs, the father of atomic work in the United States, according to Who's Who, to do a study on the feasibility of American investment in those European companies likely to benefit from the accelerated English atomic program.

I would like to emphasize that a study from this standpoint has to stand very acid tests because private investors cannot take vague chances with their funds—cannot make up the losses of mistakes from the unlimited reserves of tax receipts. The conclusion of my company's report was that the very factors that make atomic powerplants for electric generation abroad economically desirable, make these same plants extremely academic in importance and undesirable here.

Electric generation does not take place in a vacuum. It has to be related to more than the techniques of turning the dynamos. It seems to me we in America are fascinated with a new technique which lends itself readily to popular interest in its magic ways, but that this is no more the attitude which the true patriotic steward of progress should take toward atomic power than it would be to spend the taxpayers' money on fireworks on Capitol Hill every day of the year.

Many of the public discussions of the so-called lag in our program, compared with that of the British, seem to bear upon every factor but the main one, which is the vast difference in fuel costs for conventional plants here and abroad.

I call your attention to the table below which shows the trends of prices per ton of coal used in the generation of electricity here and in the United Kingdom since 1950.

Year	United States	United Kingdom	Year	United States	United Kingdom
1950	$6.38	$7.11	1954	$6.25	$9.05
1951	6.42	7.87	1955	6.01	10.00
1952	6.54	8.26	1956	6.29	10.86
1953	6.52	8.77			

You will note the cost of coal in 1956 in the United States was lower than 1950, whereas it is very substantially more in the United Kingdom.

I would like to point out that in 1956, the last year for which final figures are available, coal costs in the United Kingdom were about 72 percent above those in the United States.

Large as is this difference, it is not the final percentage to consider, because the trend of coal costs is also extremely important. Electric plants represent large capital investments which must operate 15 to 40 years to recover their capital, so one has to calculate his future as well as present expenses.

Therefore, we must note coal costs in the United Kingdom have risen each and every year since 1950, advancing under socialized

mining fully 52 percent, whereas our prices in 1956 were slightly below 1950's.

In midyear 1957 coal prices in the United Kingdom were raised again—by about 7.5 percent and there is now talk of another increase on some grades of coal this spring.

Coal prices on the Continent have also increased greatly. I make an attempt in my business to follow the status of competitive fuels abroad so I am somewhat familiar with this situation.

Wage inflation of coal prices in the United Kingdom may slow up, but it is unlikely to stop, while the cost of absenteeism offsets some of the benefits of mechanization.

Thus over the years, coal costs may edge up abroad, although perhaps not at the steep pace of the recent past.

To reduce these differences in coal costs to costs per kilowatt-hour generated, I cite the following table which gives figures in mills per kilowatt-hour.

Coal plant

	British	American
Fuel	4.30	2.60
Operations	.57	.47
Capital charges	1.38	3.16
Total	6.25	6.23
Load factor (percent)	60–80	60–80

We have cheaper electricity because ours includes a tax payment to to the Government, whereas the British electricity is socialized.

Turning now to atomic power, we find the following estimates for a British atomic plant:

	Cents
Capital charges and depreciation	0.433
Interest on fuel	.066
Fuel replacement	.288
Operations and maintenance	.066
Total	.854
Less plutonium credit	.085
Net cost	.769

The plutonium credit is figured at its present value, but the trend in the price of plutonium is decidely downward.

This net cost is above those of conventional plants in both nations and it is only justified abroad by the trend of fuel costs and the hope that later developments will reduce operating expenses.

It has been estimated by one authority that capital costs might decline 20 percent and fuel costs 45 percent by 1970, giving a cost per kilowatt-hour below 5 mills, but, of course, we can now build coal plants in the United States to deliver electricity at less than 3.8 mills.

Representative HOLIFIELD. Can I ask you if the computation of value of plutonium in that table represents about $12 a gram?

Mr. GILBERT. No, I think it is a little bit less than that.

Representative HOLIFIELD. About how much?

Mr. GILBERT. It is around 10. The price of plutonium in England has been going down for some time but I will supplement that with the exact price.

Representative HOLIFIELD. Why is the price going down? They are embarked on a weapons program. Do they not anticipate using this plutonium for weapons as we do?

Mr. GILBERT. I have no military secrets. All I know is that the supply and demand is such that the price keeps edging off and the long-range forecasts I have seen on it indicate that there is doubt that it will stay where it is.

Representative HOSMER. As a matter of fact, the plutonium in the United Kingdom is produced by the Government itself so there is really no supply and demand situation in the normal sense, is there?

Mr. GILBERT. There is not in the normal sense.

Representative HOSMER. Is that not an artificially established price by the British Government set up to show somewhat favorable generation costs on electricity?

Mr. GILBERT. I would presume that they see more and more plutonium coming or about to come in their possession and they don't see many present uses.

Chairman DURHAM. Of course, they do not export any. It is all in the Government operation.

Representative HOSMER. This is just shifting the accounts between different departments of the Government.

Mr. GILBERT. That is true, except that they are inclined to look at the possible immediate uses for it and the technicians who have figured this, and I have gone over quite a few of their accounts, all indicated a further weakening in the price.

Perhaps sputnik has changed that.

Representative HOSMER. When you say price in this connection, it is not merely price; it is the amount that one part of the Government credits another part of the Government for a product.

Therefore, it does not depend upon supply and demand, but upon, to some extent, political and economic factors in the Government itself.

Mr. GILBERT. I think the British Government is inclined to draw up its idea of values as close to at least a theoretical supply and demand situation as it can.

However, I have not checked this price in the last month or two. I will be glad to do so again.

Representative HOLIFIELD. As a matter of fact, the price is set in England on the fuel value at $12 and they are thereby penalizing their cost of electricity, whereas in America, if we set it $30 on a weapons value we are subsidizing our cost of electricity from the same reactor.

Mr. GILBERT. There is a tremendous discrepancy there.

Representative HOLIFIELD. So in both cases an arbitrary setting of price is based on an evaluation which the Government makes. In neither case does the Government sell plutonium to an outside purchaser and it is the only buyer.

Mr. GILBERT. But I think the Government, with all of these plants it is starting to build, that are going to use uranium and have byproducts of plutonium, foresees a considerable amount of plutonium.

I do not know whether that was a factor in this calculation, or not.

Representative HOLIFIELD. This is very interesting, you know, because it is general knowledge, I think, that these great plants that they are building are going to produce a great deal of plutonium.

Mr. GILBERT. Right.

Representative HOLIFIELD. And if the market is $12 I sometimes wonder what we are talking about, establishing a 15-year contract at $30, when we could undoubtedly buy from the British, they will be glad to sell it to us, at $12 or even less, their complete output.

Mr. GILBERT. They thought $7 in 5 or 10 years, I think. That is before sputnik became an issue, though.

But their program is very large and they are going to have a lot of plutonium. Of course, I don't know how much goes into each weapon.

Representative HOLIFIELD. Well, it is not necessary to know that.

Chairman DURHAM. All right, you may proceed, Mr. Gilbert.

Mr. GILBERT. We in America surely do not wish to generate inflation instead of electricity, but this is exactly what this committee will be doing if it commits the taxpayer to the use of his money for uneconomic powerplants here or subsidies for such plants exported abroad. Money is needed in hard times for less wasteful projects more likely to raise the standard of living in real terms in the final audit of account.

In making my study I could not help but notice the great discrepancies between the operating results of the European electric systems, which are mostly socialized, and ours.

I bring out this point because there is a danger that we may indulge in a socialized electric industry here due to the discovery of the new form of energy.

The capacity of our enterprising Nation to generate electricity is now greater than that of the next seven great countries of the world. In 1950–56 Europe's industrial production grew 45 percent, with an increase in electric generation of 63 percent, while the United States production gained 27 percent, with an increase in electric generation of 82 percent.

The lower growth of electric generation abroad is undoubtedly due to the unimaginative inefficiency of the socialistic managers of the powerplants.

In 1956 Europe had 104,200,000 kilowatts of installed capacity, while had a capability of 126,500,000 kilowatts, yet Europe generated 388 billion kilowatt-hours compared to our 600 billion kilowatt-hours. The pink powerplants had a utilization of only 42.9 percent of capability in contrast to ours of 54.5 percent.

The Socialists tend to built smaller powerplants, operate them at lower temperatures and pressures, and to use lower voltages on transmission. Also they take longer to build a plant and spend much more per kilowatt, even though equipment costs less than ours. In 1956 European thermal plants used 1.51 pounds of coal per kilowatt-hour, compared to the average of 0.935 pounds in the United States.

In appearing before you, I would like to comment upon another aspect of the atomic program, mentioned as item No. 1 on your sheet "Topics for discussion."

24041—58——32

Over the years the Government has acquired large inventories of uranium in various forms from ore to metal. Contrary to the practices of private business, these inventories have been written off as acquired instead of being carried at the lower of cost or market.

There are now enough quotations for uranium in all forms to give it a market value. The sums invested in this stockpile should be valued as a business values its inventories, annually, and the funds so disclosed, previously lost in expenses, restored to the budget for a needed tax cut or other worthy purposes.

This is only sound practice, for property written off is less likely to be treated carefully than that which must be accounted for each year.

Furthermore, this inventory is to be increasingly disposed of in the next decade as uranium-burning plants arise all over the world, and the taxpayer has a right to know where he stands on potential receipts.

I thank you.

Chairman DURHAM. Mr. Gilbert, you certainly have given us some information we have not had before this committee. I am certainly glad you have brought out these points.

Mr. GILBERT. Thank you, sir.

Chairman DURHAM. You must have made quite a study of this whole problem.

Regarding your last statement regarding the stockpile, I believe there is very little in the stockpile. We do not carry a stockpile of uranium ore except as we use it.

We are troubled, of course, with this matter of trying to keep the mining industry in business. That is one of our problems that we always face when we build up a mining industry in America, we go from rags to riches and back.

That has been historical with the America mining industry.

I do not believe that is a sound program. I think the stockpile is essential.

Representative HOLIFIELD. I want to aline myself with the chairman's remark on stockpiling. It so happens that we do not have a great stockpile at this time. Most of the ore has been fabricated. There are, of course, current stocks, you know, but there may develop a situation in the future and you do make a point I think which should be considered and that is when we start loaning the inventory in the form of fuel rods to reactors all over the world, we are in effect taking a capital asset of the United States and disposing of it whether it be on a lease or loan basis and I think that the taxpayer does have the right to know how many of the fuel rods will be loaned at 4 percent, for instance, to a foreign nation and how much the inventory cost is and this would come out, I think in each bilateral agreement, there would be a definite statement of the current inventory value so that there would be a cumulative accounting of it. That is an important point to be considered.

Mr. GILBERT. I wonder, sir, if the uranium in metal form or ore form may not be substantial. It may not be all in the stockpile. Of course, that has been charged off.

If you were a company in the uranium business you would carry it at the cost or market.

Representative HOLIFIELD. The Government operates a little bit differently with its resources. There has long been a question as to

whether or not the Government should put an inventory value on these Government buildings, and carry them as an asset in place of an expended amount of money.

This goes into the whole wide range of Government inventory and its accountability.

We have never considered our Government assets in the way of an inventory, making an inventory value of them, because we are not set upon that basis, apparently.

Mr. GILBERT. Doesn't the Farm Bureau carry its crops in the Commodity Credit Corporation and borrow against them? Crops that they buy?

Representative HOLIFIELD. The Commodity Credit Corporation carries its stock on an inventory value because of the fact that they loan to the farmers money against that stock, but when it comes to disposing of those stocks, it is not necessarily disposed of on a profit basis as private industry would.

It is used for the purpose of the Government, such as wheat to India, for instance, and use of commodities for school lunches and in distressed areas.

So we do not carry it exactly on a business basis.

Chairman DURHAM. Mr. Hosmer?

Representative HOSMER. I have no questions.

Chairman DURHAM. Thank you very much, Mr. Gilbert, for your statement. We appreciate your coming before the committee.

Mr. GILBERT. Thank you.

Chairman DURHAM. The committee is adjourned until 2 o'clock this afternoon. We will meet here in this room.

(Thereupon, at 12:30 p. m., the committee was recessed, to reconvene at 2 p. m., the same day).

AFTERNOON SESSION

Chairman DURHAM. The committee will come to order.

This afternoon meeting begins with Dr. Thomas H. Johnson as the first witness.

STATEMENT OF THOMAS H. JOHNSON, VICE PRESIDENT AND GENERAL MANAGER OF RESEARCH, RAYTHEON MANUFACTURING CO., WALTHAM, MASS.

Mr. JOHNSON. Thank you, Mr. Durham.

I am no stranger to you, Mr. Durham, but in responding to your invitation to testify today, I want to be identified as one who is experienced in the administration of research and as a representative of a great research and development company which is advancing a promising reactor concept for producing electricity inexpensively from the atom.

Perhaps the most valuable contribution I can make to these hearings is to give a specific example of an idea that could, if pursued, break through the cost barrier which now obstructs our progress in atomic development.

For 2½ years, Raytheon has been exploring a design of a liquid metal fueled gas-cooled reactor for the generation of electricity. If

successful, this concept would outmode other concepts now being designed for earlier operation, and it would advance the United States a long way up the road toward economically competitive nuclear power.

The liquid metal fuel in this reactor would be a solution of enriched uranium in bismuth. Since it can maintain a high temperature without excessive pressure, the fundamental limitation of the water-cooled reactors would be avoided. The heat would be removed by nonradioactive, chemically inert helium, which on passing through a tubular boiler, would produce steam of the high quality used in modern steam turbines. When technology develops, the helium could be used even more efficiently to drive a gas turbine. In using liquid metal, we would avoid the costs of fabricating and processing solid fuels. By continuously removing xenon and other volatile fission products, the amount of uranium in the reactor could be held to that actually needed for normal operation, making the reactor inherently safe. Control rods would not be needed, for the negative temperature coefficient of reactivity would regulate the generation of heat to the actual requirements of the power load. More than 80 percent of the enriched uranium added day by day to the core would be consumed in the generation of heat and the reactor would operate for 5 years before the charge would have to be drained for reprocessing.

As a venture into the high-temperature regime, the liquid metal fueled, gas-cooled reactor could be alternatively regarded as a reasonable first step toward a still higher temperature reactor for gasifying coal, a process which would enhance its energy and provide a gaseous fuel for use in conventional burners. The liquid metal fueled gas-cooled reactor is also a versatile concept which could be adapted to burn uranium or plutonium, or it could breed uranium 233 or plutonium. It could be built either as a thermal or as a fast reactor.

This reactor concept is an example of the direction in which research should proceed if we are to reach the goal of economic nuclear power in the United States. Since water-cooled reactors are not able to produce high-quality steam because of the limitations of materials of construction, the prospects for reaching economic nuclear power by that route seem dim in comparison. There are, of course, unknowns in any advanced concept but these should not frighten us.

The record of atomic research is impressive in finding solutions often surprisingly close at hand.

In the case of the liquid metal fueled, gas-cooled reactor, the principal problem is to find a material to contain the molten fuel and through which helium will not leak. We already have a very promising lead to a possible solution of that problem.

In view of the current discussion of the roles of Government and industry in nuclear power development, it is important to understand why a company like Raytheon is interested in a nuclear power project and how it is able to deal with the variety of problems involved in designing a nuclear powerplant incorporating high-temperature materials, nuclear fuel, neutron moderation, gas circulation, a steam cycle, and electric generation, and then to fit the whole package into the economy of the utility industry.

Raytheon is an electronic company with 80 percent of its sales to the Government. It has systems responsibility for the Navy's air-to-air

missile, Sparrow III, and for the Army's ground-to-air missile, Hawk. Raytheon is the largest manufacturer of microwave power tubes in the free world. Raytheon designs and manufactures radar equipment of all kinds, including arctic DEW line radars, air-traffic control radars for CAA, storm finders for the Weather Bureau, and bombing and navigational radars for the Strategic Air Command.

Raytheon is the largest research and engineering company and the only one engaged in civilian nuclear reactor development in New England where nuclear power will become economic before it can be generated at a profit in other parts of the United States.

Moreover Raytheon has close relations with the very excellent educational institutions in the Boston area where nuclear engineers of high quality are now being trained in considerable numbers.

In connection with its manufacturing, Raytheon has acquired a wide experience and unique skills in producing ceramics, high-temperature metals, and in dealing with liquid metals and other materials at high temperature. Because of its situation and experience Raytheon realizes that it can make a unique contribution to the development of nuclear power.

But its experience does not qualify Raytheon to engineer all features of a nuclear powerplant. To complement its own capabilities, an association of industries has been formed under the name American Nuclear Power Associates. Besides Raytheon, the ANPA comprises Burns & Roe, Inc., a New York firm of engineers and constructors; the Griscom-Russell Co., which specializes in boilers and heat exchangers; Clark Bros. Co., one of the Dresser Industries, specializing in engines, compressors, and turbines; and the Orange & Rockland Utilities, Inc., of New York State.

Arrangements have also been made to bring in several other New England utilities, but these have not yet been announced. The total business of the utilities in the American Nuclear Power Associates, including the new associates, exceeds that of the Boston Edison Co. This entire group of industries has enthusiastically placed its bets on the liquid metal fueled, gas-cooled concept and out of the variety of its experiences and skills, the associates working together can bring the full range of industrial competence to bear on the design of a complete nuclear plant.

Raytheon has already spent about a half million dollars on the liquid metal fueled gas cooled reactor and the associates have agreed to spend $360,000 more over the next 2 years. However, the risks are entirely too great, the patent situation too involved, and the day of profitable return on investment too far down the road to attract enough private capital to finance the entire cost of developing this reactor, an amount estimated to be about $11 million exclusive of construction costs.

It is much more reasonable to expect private funding for the first power station after the necessary research has resolved the technical problems.

We have, therefore, submitted a proposal to the Atomic Energy Commission to support an initial research program for 2 years at a cost of $2.3 million. This support would permit us to explore the materials problems and determine whether the liquid metal fuel gas cooled concept can make good on its present promise.

We are confident that the merits of our proposal will be correctly evaluated by the Commission in line with national policy.

In embarking upon a program of research in the nuclear-power field, we at Raytheon have asked ourselves whether we are charting a course for the company into the field of manufacturing power-generating equipment. Our answer to that question is, "No, not necessarily." Those decisions would have to be made after the project has developed to the point where it can be evaluated as a profitable enterprise considering markets and related activities of the company.

Raytheon is now deely involved in military projects. If the happy day should come when peace and reduced armaments become realities, it will be necessary for Raytheon to expand in some other direction which we cannot now foresee. Certainly the manufacture of reactors is one of the lines we must consider.

But the reason for our immediate interest in this project is our belief that we are uniquely able to make a contribution to the development of nuclear power. We have a highly competent group of scientists who are enthusiastic and eager to develop a very promising reactor concept. We have relevant background of industrial know-how, and our associates will round out our own capabilities to make a well-balanced team. If we can be supported financially, we believe our efforts will significantly strengthen this country's position in the nuclear-power field 10 years from now. We believe these are the only considerations that can meaningfully guide our research efforts at this stage.

That, Mr. Durham, states Raytheon's position, and I think it should be useful in these hearings to have a specific example of an advanced reactor concept and an industrial situation which is prepared to go ahead with it.

Chairman DURHAM. Thank you very much, Doctor. It is a new concept which has never been proposed before, is that not true?

Mr. JOHNSON. This is different from anything that has been proposed before. It is related somewhat to the Brookhaven concept but we believe this has advantages which would make it come in before that concept.

Chairman DURHAM. An old company which has been in the research field for many years, has an able group of specialists in all fields, does it not? It covers the entire field of basic research?

Mr. JOHNSON. That is right. We have over 3,000 engineers and scientists in the Raytheon company, working largely in the materials fields.

Chairman DURHAM. You have physicists, chemists, and metallurgists and the whole range of scientists?

Mr. JOHNSON. Yes, sir.

Chairman DURHAM. How are these people participating? Is it by jointly giving so much in the way of funds?

Mr. JOHNSON. They are putting in manpower.

Chairman DURHAM. At the present time they have not put any funds into it?

Mr. JOHNSON. The money that is represented by the $360,000 would be spent as salaries and support of manpower.

Chairman DURHAM. That comes entirely from Raytheon?

Mr. JOHNSON. No. The manpower would come from the associates.

Chairman DURHAM. The money comes from where?

Mr. JOHNSON. The men are paid by their parent company.

Chairman DURHAM. The parent company?

Mr. JOHNSON. Yes, sir. But they would form a group at Waltham.

Chairman DURHAM. I suppose you consider the matter entirely in the field of research?

Mr. JOHNSON. Yes. It would be 2 years before we could determine whether this concept will make good on its promise. That period will be spent on research in materials.

Chairman DURHAM. Your proposal would come under the Research and Development Division of the AEC.

Mr. JOHNSON. It would come under the Reactor Development Division and their materials program.

Chairman DURHAM. It would not come under the power program?

Mr. JOHNSON. It could be conceived under the power program, too. We would hope eventually that it would come under the civilian-reactor program, but it might get started as a research in materials.

Chairman DURHAM. I notice you say the concept is not controlled by rods.

Mr. JOHNSON. That is right. We never have to put more uranium in this reactor than we need to make it go. So we do not need to neutralize the material that is there by rods. There is a negative temperature coefficient of the activity which would regulate the heat to the actual powerload.

Chairman DURHAM. I was thinking of the actual control of cutting it off and putting it on.

Mr. JOHNSON. It would have to have some device which could shut it down. Normally, if you just turn off the generators, the load requires no more power and the reactor would shut itself down to an idling condition.

Chairman DURHAM. I notice you said also it would run 5 years on 1 load.

Mr. JOHNSON. That is right. You would add uranium day by day. A small capsule of uranium would be added each day.

Chairman DURHAM. It is a very unique type of reactor.

Mr. JOHNSON. This is the only one I know of that has this feature.

Chairman DURHAM. Mr. Price, do you have any questions?

Representative PRICE. No questions, Mr. Chairman, except to say that I am glad to see Dr. Johnsqn back with us.

Mr. JOHNSON. Thank you, Mr. Price.

Chairman DURHAM. Mr. Hosmer?

Representative HOSMER. Yes, I would like to ask Dr. Johnson a question or two. With respect to the reactor concept you have here, how does it differ with the Pennsylvania Power & Light? They have a homogeneous reactor. They do not use the liquid metal mixture.

Mr. JOHNSON. They will use a slurry of uranium thorium oxides in heavy water.

Representative HOSMER. That is the difference?

Mr. JOHNSON. Yes.

Representative HOSMER. Is the intermediant coolant different?

Mr. JOHNSON. I am not entirely sure that I know the Pennsylvania concept accurately, but my belief is that either there is a cooling coil inside of the reactor where steam would be generated, or else the fuel itself is circulated to a heat exchanger where steam would be generated.

Representative HOSMER. They do not have an intermediate loop like you have?

Mr. JOHNSON. The intermediate loop here is a gas loop. We use helium to cool the reactor.

Representative HOSMER. Why do you use gas rather than the liquid sodium?

Mr. JOHNSON. Helium is nonradioactive, whereas sodium gets very active. We avoid, therefore, the requirements for extreme integrity of the cooling system.

Representative HOSMER. How about water? Would that not do as well?

Mr. JOHNSON. The problem with water is to get the cooling through the use of fine tubing. Water cannot be contained at modern steam pressures in a large pressure vessel because of the limitations of the steel.

Representative HOSMER. It is a better heat transfer agent than the gas, is it not?

Mr. JOHNSON. The helium is a good transfer agent. It would be operated at 500 pounds per square inch pressure. It is the best gas coolant that you can name.

Representative HOSMER. Thank you. That is all.

Chairman DURHAM. Have you made any calculation on the temperature, Doctor?

Mr. JOHNSON. Yes. The temperature of this reactor would be modern steam temperatures, 1,250° F. As technology develops so that the gas could be used directly in a gas turbine, this temperature could go still higher.

Chairman DURHAM. I notice you referred to conventional-type plants, such as coal plants. How would the application come in there?

Mr. JOHNSON. This is a way one could supply heat for gasifying coal. You need high temperature heat for gasifying coal. That process would transfer the energy from the nuclear power to the coal, enhancing its latent energy and putting it in a form that could be burned in a conventional burner. That is an interesting aspect. I think it is a long-range possibility but this would be the sort of first step in that direction. It opens up a new possibility for the use of coal which may be interesting.

Chairman DURHAM. Are there any further questions?

If not, thank you very much, Doctor. We are glad to see you back with us.

Mr. JOHNSON. Thank you, Mr. Chairman.

Chairman DURHAM. The next witness is Dr. Norman Spector, vice president, Vitro Corporation of America.

STATEMENT OF NORMAN A. SPECTOR, VICE PRESIDENT, VITRO CORPORATION OF AMERICA

Mr. SPECTOR. Thank you, Mr. Chairman.

Chairman DURHAM. Doctor, you may proceed.

Mr. SPECTOR. Vitro Corporation of America is a diversified industrial organization engaged in the new technologies of the atomic age. Many of our divisions operate in the field of nuclear energy, mining, and advanced metallurgy and our activities include exploration and mining of uranium, thorium, and rare earth ores. We are also en-

gaged in the milling, processing, refining, and recovery of uranium, thorium, rare earths, and rare metals. We are engineers, designers, and constructors of nuclear materials processing plants and other nuclear facilities including the production of nuclear power. We are heavily committed to and engaged in the nuclear program in this country and abroad and have a substantial investment in this connection. Accordingly, we appreciate this opportunity to appear before your committee.

There are many elements that go into the definition of an atomic power program. However, I should like to limit my comments for the moment to two major elements which we feel are by far the governing factors in the definition of a more aggressive and successful program. These are time and the establishment of a kilowatt goal.

We feel that it is most important to define a new national program to achieve economic atomic power in terms of a specific time over which major effort is to be expended and the goal achieved. It has been held by experts that the present program will produce competitive power in 15 to 20 years if vigorously executed. We believe this is too long and that the program should be geared to not more than 10 years to achieve this goal.

This is not to say that we necessarily need this nuclear source of competitive power in this time but rather that it will be wise to think in these terms, especially in view of the international considerations. If, as has been reported in the press, there is informal agreement on a target date of 1968 for attainment of economic nuclear power in the United States on the part of this committee and the AEC, we believe that a major step forward has been taken.

We believe, however, that it is equally important that a kilowatt goal be established in conjunction with this timing. I understand that the Atomic Industrial Forum poll has revealed that a 3 million electrical kilowatt goal is favored by the majority of firms which participated in this survey; but that close behind were the suggestions that a 2 million electrical kilowatt goal be established, and that no goal be established. It is difficult for me to argue as between 2 or 3 million electrical kilowatts as a goal at this stage, and I do not really know how one arrives at such numbers, but I do find it relatively easy to argue for a fixed goal of substantial size.

It seems reasonable to aim at a figure of 2 million electrical kilowatts over this period in view of our policy to examine and develop promising types of reactor concepts since it appears probable that many routes toward the eventual goal of economic power will have to be evaluated. I would also like to suggest international considerations seem to justify the establishment of such a goal since this will serve notice in terms that the free world can understand of our intent to assume leadership in this field. I appreciate that total kilowatts of installed and operating nuclear electrical capacity is not of itself, necessarily, a measure of leadership in the application of the peaceful uses of atomic energy. However, for us to ignore that it is an important factor is to display an unfortunate lack of appreciation of the criteria by which the rest of the world measures leadership.

If we define these two elements of policy in such specific terms I feel we will have gone far to achieve our objectives both domestic and foreign. I say this because we will then have set a well-defined goal and a time schedule. This must and will speed decision-making

processes. The specific ingredients of our program within this framework are, of course, less easily defined but it seems clear that we can quarrel less with the detailed conduct of the program if there is general agreement on the objective and the timing. Indeed, I suggest that both industry and government could each afford to be more considerate and yielding in approaching their mutual problems if these two basic elements were agreed upon.

Our own opinion of the specifics of a program under these ground rules suggest that we emphasize—

1. Fuel development as a separate program.
2. Fuel reprocessing.

We feel that our reactor concepts should include:

1. Natural uranium.
2. Thorium uranium.
3. Gas-cooled concepts.

On the matter of size we suggest that the program focus on two classes of reactor size; these being 50,000 electrical kilowatts and smaller, and 150,000 electrical kilowatts and larger.

The Atomic Energy Commission has established the conditions under which it is prepared to contract with operators of private nuclear reactors to provide for chemical processing by the Commission of spent fuel from their reactors. In so doing, the AEC has set a basis on which private industry can start to understand what is expected of it in this field, and to evaluate the status and direction of this part of the nuclear-power cycle.

I will not repeat the principle features of the Commission's notice since the information is a matter of public record and well known to those involved in the field.

Unfortunately, after soliciting interest by industry in providing a spent fuel processing facility, the AEC has decided that none of the proposals received were acceptable. We feel that the ground rules laid down by AEC were so severe as to make this almost a foregone conclusion. Because the AEC commitment to offer reprocessing services did not take exception to any type of fuel, the facility which they would like to see must be large and diverse. The AEC has considered as their own basis for evaluation of the industry proposals that the plant is amortized at 10 percent a year and they have not included profit, taxes, insurance, land, and so forth. They have added a 15 percent AEC overhead charge. They have further indicated that a price by industry of 15 percent above their own price would be considered reasonable. Moreover, to be responsive the AEC hoped that industry would offer to process as many of the different fuels as possible, and not simply select the best.

On the face of it, this is a discouraging picture for industry. We must amortize at something like 15 percent a year, allow for land, taxes, insurance, cover our process risks, consider process obsolescence, and then try to make a profit. It seems small wonder, then, that industry cannot compete with Government even when given a 15 percent differential in price. We would like to see AEC take another look at their invitation and revise the basis for their evaluation to reflect a more realistic appraisal of the State of processing art, the many types of different fuels which must be processed, the different cost structure of private industry compared with that of the Government; and then try another round with the companies who are seriously interested in

getting into this field but cannot afford the present risks and cannot compete with AEC on the terms outlined.

I referred to international considerations in making my two major points in connection with our domestic power program. I do not really think the two can be divorced at this stage. The peaceful uses of atomic energy are instruments of international policy. Our leadership in this area will help to achieve economic health in a free world, and with it a greater promise of peace.

What does it take, then, to achieve this leadership? I submit that it takes more than we are doing now and that it takes more than a program which fits our own timing, our own problems, and our own preferences; that it takes more than a domestic satisfaction with what we are doing and confidence in our own ultimate ability and superiority. We must export concrete signs of our leadership in terms that the free world will recognize and will therefore accept. We cannot expect them to accept us as leaders in the field simply because we say so.

The definition of leadership in this field is itself very difficult. I suppose the optimum situation would be for us to have a program which was producing the most electrical kilowatts using the most advanced types of reactors and producing power at the lowest cost in terms of mils per kilowatt-hours. Advanced types, of course, would imply very low investment, simple fuels, and so forth. This is an optimum definition of leadership. The point I wish to make, however, is not that we must achieve this optimum, but rather that there is no single criterion of leadership. What we need is a program which has some element of each of these factors. Therefore, we cannot ignore a specific and significant total electrical kilowatt goal. We cannot depend simply on a program which has as its main claim to fame the investigation of many types of advanced reactor concepts.

I have been abroad five times in the last 2 years and my associates have also spent much time with our friends overseas. One gets the feeling very clearly that these countries do not wish to launch programs to realize the ultimate advantages of nuclear power; indeed, they cannot afford the cost either in money or manpower. Accordingly, they all hope that we will continue our programs and policy of reactor development. However, human nature being what it is, they also take the attitude that our continuing reactor development effort is essentially for our own benefit and that the good which will result to Europe and the rest of the world is simply incidental. Of course, this is an oversimplified attitude and, like all too simple conclusions, it is not strictly true and certainly unfair to us.

I do not think our foreign friends mean to be unreasonable but rather prefer to think that a certain lack of appreciation, and with it a large degree of inability to accept our leadership, comes from the fact that they see the results and benefits of our programs as coming too far in the future to meet their present needs. In fact, sometimes they do not see it at all—and again I think because they are so preoccupied with their problems of today.

It is important, therefore, if we are to reassert our leadership in matters of the peaceful atom that we include in our overall planning a specific program designed to assist the free world in realizing early competitive nuclear power and ultimately the most economic nuclear

power with minimum dependence on the United States for enriched fuel. Such a program must recognize that our foreign friends need assistance in financing fuel charges at present levels.

They need the help of higher plutonium repurchase prices. They would like to see some of our research aimed at their special circumstances and directed at achieving advances in fuel technology at an early date and especially in a manner which makes them more self-sufficient.

Such a program is not a giveaway plan. At least, I do not propose one. Our own economic interests will benefit greatly and directly at the same time. If indeed there does remain a modest incremental difference above what we would do for our own purposes, then it seems a very small price in any event to pay for establishing American leadership in the eyes of the world for the peaceful application of atomic energy.

I appreciate that certain of the suggestions which I have just made are not new and I am encouraged to read that several are contained in the working paper which was prepared at an informal meeting late last year between members of the Commission and some members of this committee. I have included these points in this statement because I wish to emphasize that these matters have been discussed by me and my associates over the last year with many foreign power groups both here and abroad. I am certain that these are the types of actions which our foreign friends hope and expect that we will take to demonstrate in concrete terms a program of maximum help.

I have a specific suggestion for your consideration which I feel has merit in demonstrating our sincere interest in assisting foreign power groups. I suggest that the AEC issue a fourth-round invitation under the reactor demonstration program which would be limited or at least would give preference to proposals which were made in cooperation with foreign power interests.

I firmly believe that such a program would have many benefits. It will bring European brains and manufacturing know-how into the package. In addition, it will greatly increase the prestige of the United States program over the entire world. It is also reasonable to expect that specific projects which are accepted should be carried out at lower costs to the United States because of generally lower costs abroad. Even assuming certain of these types are not of immediate or particular interest to the United States program, it will at the very least enlarge our design and operating experience in the general field. Finally, such a program would add to the kilowatt total which is listed under the United States banner and strengthen our claim to leadership in the field, especially in those areas where this parameter of leadership is highly regarded.

Chairman DURHAM. Thank you very much, Dr. Spector.

You have made some excellent suggestions. On page 3 of your statement you speak about the difficulty of private industry getting into the processing business. Your statement said that industry is very much concerned because of the formula laid down by the AEC to carry out the building of the type planned.

Do you recall the number of applicants that have come in and offered proposals for building this processing plant? I do not recall the number.

Mr. SPECTOR. To my knowledge, there were received by the Commission some 6 or 7 answers to their invitation from firms that they considered responsible and interested in the program.

Chairman DURHAM. Did you see a copy of the proposal laid down by the Commission entirely?

Mr. SPECTOR. No, sir; I did not, except that we did receive from the Commission the important elements of the basis which they used to evaluate industry proposals against.

In other words, they did supply the cost of their plant, the operating cost and, in general, the characteristics of the type of facility that they felt was necessary. I felt that we were well informed on what the Atomic Energy Commission proposed to do for their own part.

Chairman DURHAM. I think that is so important that information concerning AEC policy on this question should go into the record, and I authorize the staff to secure the necessary information and put it in the record at this point.

(The information referred to follows:)

UNITED STATES ATOMIC ENERGY COMMISSION,
Washington, D. C., January 3, 1956.

Hon. CLINTON P. ANDERSON,
Chairman, Joint Committee on Atomic Energy,
Congress of the United States.

DEAR SENATOR ANDERSON: The Commission has recently approved a program to encourage private industry to build and operate chemical processing plants for the recovery of source and special nuclear materials from fuel materials irradiated in research and power reactors. The goal of this program is to have commercial processing plants in operation as it becomes necessary to process fuel elements from privately owned power reactors. The purpose is to establish a foundation for a commercial chemical separations industry which will assure that the processing needs of the growing atomic power industry can be met as they arise.

We believe that this program, if successful, will significantly advance the goal of an economically competitive nuclear power industry free of major dependence on Government assistance.

Under this program the Commission will make available irradiated fuels from its own reactors and from foreign purchases for commercial processing at reasonable prices. The materials which are to be made available will be those from AEC research and developmental reactors, from foreign purchases, and nonstandard materials from production reactors.

Interested companies will be invited to submit, about 18 months from now, proposals in which, among other things, the types and quantities of AEC materials they wish to process, the time periods for which the materials are desired, and their prices, will be specified.

The Atomic Energy Commission will provide interested companies access to AEC-developed technology and the use of AEC facilities for research, development and training, at full costs to the user.

The proposals received under this program will be evaluated in accordance with the following criteria, which will be made a part of the original invitation for proposals:

(*a*) Advancement of the art: This will include consideration of the economies of the proposed plant, its versatility for handling a wide range of fuel types; and the development program proposed to be conducted both before and after plant startup.

(*b*) Prices: Prices will be evaluated against those of all other proposals for processing the same fuels, and must not exceed the fair value of the services performed. In determining that prices do not exceed the fair value, consideration will be given to the full cost of performing the same services in AEC facilities.

(*c*) Capacity and startup date of plant: Other factors being equal, some preference will be shown for plants with early startup dates and/or large capacities.

(*d*) Responsibility for disposal of wastes: Since the development of economical waste disposal methods, or the exploitation of the use of fission products

is one of the principal goals of the program, the manner in which the waste disposal problem will be handled will be of major importance.

(*e*) Agreement with private reactor operators: Evidence will be required that satisfactory arrangements can be made with the operators of the privately owned power reactors to process their fuels. (No proposal would be considered which does not involve the processing of fuel from at least one private power reactor.)

(*f*) Assurance against abandonment of project.

On the basis of its evaluation, the Commission may accept one or more of the proposals, or may reject all.

We shall be pleased to discuss this program with you further, and, at your convenience, to answer any questions you may have.

Sincerely yours,

W. F. LIBBY, *Chairman.*

UNITED STATES ATOMIC ENERGY COMMISSION,
Washington, D. C., October 25, 1957.

HON. CARL T. DURHAM,
Chairman, Joint Committee on Atomic Energy,
Congress of the United States.

DEAR MR. DURHAM: In my letter of January 3, 1956, I advised you that the Commission had approved a program to encourage private industry to build and operate chemical processing plants for the recovery of source and special nuclear materials from fuel elements irradiated in research and power reactors. The form of encouragement was an offer by the AEC of a quantity of irradiated fuel elements from its own or military reactors which would serve as a base load for a private plant processing irradiated fuels from private reactors.

Before a formal invitation was to be sent to interested companies, it was decided to approach industry on an informal basis to determine their interest in participating under the terms and conditions of our proposed program. Information on the AEC proposed program was sent to 108 organizations during the first week of April 1957 and was furnished to members of your staff on April 22, 1957. A general meeting was held on April 25, 1957, to discuss, with those companies still interested in the proposed program, the background to our proposal and to answer any questions which had arisen from their study of the information made available to them.

The AEC received 18 replies from the 108 organizations which received the package of information on the proposed industrial participation program. This survey of industry's reaction to our program revealed, among other factors, that the processing loads which would be available in the next few years would not be sufficient to enable a processor to process the available fuels at reasonable prices, on the basis that these charges which were in the order of 15 percent higher than the AEC's schedule of charges for processing the power fuels would be considered reasonable. Among the factors which made the investment in chemical reprocessing unattractive at this time were the uncertain fuel loads from the private reactors and the unknowns in the storage and disposal of radioactive wastes generated by the new chemical processes required for the power fuels.

We are now making plans to process, until industry can provide the processing facilities, the irradiated fuels from licensed research and power reactors by modification of existing radiochemical facilities. Additional authority and funds will be required in fiscal year 1959 before the necessary modifications to our facilities can be initiated. We feel that this approach will enable the AEC to make better utilization of its current large capital investment in radiochemical processing facilities. This plan will also make it practical for us to adjust quickly this interim processing program, with a minimum of effort and cost, as private industry installs capacity for processing these irradiated fuels.

The AEC still has as its objective the chemical processing of irradiated fuels from research and power reactors in commercial facilities. The processing services will be provided for by the AEC only for an interim period of time and the AEC contracts with the reactor operators for providing for such processing services will be subject to cancellation on 12 months' notice, if the AEC finds that fuel elements processing services will be available commercially at reasonable prices.

Although the Commission does not intend to issue an invitation for proposals, along the lines of our earlier draft, the AEC will be considering proposals from

industry and discussing with interested organizations any suggestions which might lead toward the development of an acceptable basis for industrial participation in the field. The offer of a guaranteed base load will be reviewed again when a proposal from industry indicates that the offer of such assistance to industry may result in satisfactory arrangements for the processing of private reactor fuels or when new developments warrant such consideration.

A copy of the press release on this program which will be issued at 11 a. m. on October 28 is enclosed. Mr. R. W. Cook will review the AEC program in chemical processing during the American Industrial Forum Conference on October 28, 1957.

We shall be pleased to discuss this program further with you, and, at your convenience, to answer any questions you may have.

Sincerely yours,

K. E. FIELDS, *General Manager.*

UNITED STATES ATOMIC ENERGY COMMISSION, WASHINGTON D. C.

(For immediate release, Monday, October 28, 1957)

AEC PROPOSES TO PROCESS SPENT FUELS FROM PRIVATE RESEARCH AND POWER REACTORS FOR INTERIM PERIOD

The Atomic Energy Commission is planning to process in existing Commission radiochemical facilities, for an interim period, the irradiated fuel elements discharged from research and power reactors. This decision is the result of a Commission survey of the chemical industry that revealed that industry is not ready at this time to undertake the radiochemical processing of private fuels under the current Commission program for industrial participation in chemical processing.

The survey showed that industry believes that the prospective income from the business available from the Commission and private reactors is not sufficient to warrant the risks involved in a very substantial investment in new facilities, in the face of uncertainties as to the future rate of growth of the industry, the composition of the fuel elements that will be used in the private reactors, and the problems associated with waste storage and disposal.

Chemical processing plants constitute an integral portion of the fuel cycle of nuclear reactors. They perform the operations of recovering the fissionable and fertile materials present in the irradiated fuel elements for reuse, and of placing the radioactive fission products in disposable or usable forms. At the present time, chemical processing of spent fuels is performed only by Government-owned plants at various Atomic Energy Commission sites. The irradiated fuels from the private reactors would also be processed at these facilities, which would be modified as necessary to handle such irradiated fuels. Before these facilities can be used to process these fuels, additional funds must be obtained to make the necessary modifications.

The Commission has not altered its objective of having private industry build and operate plants for the chemical processing of irradiated fuel elements from research and power reactors. Therefore, the processing services are planned to be performed by the Commission only for an interim period, and the Commission's agreements to provide for such processing services will be subject to cancellation on 12 months' notice, when fuel element processing services become available commercially at reasonable prices.

THE 1957 NUCLEAR INDUSTRY—WHAT THE AEC EXPECTS OF INDUSTRY

Speech delivered by R. W. Cook before the Fourth Annual Conference of Atomic Industrial Forum October 28, 1957, New York, N. Y.

I am pleased to have this opportunity to review briefly with you the AEC's plans for chemical processing of spent fuels from licensed reactors, and the role which we feel industry should take in this segment of the overall nuclear fuel cycle.

Because its high value, both monetary and military, demands that the special nuclear material in spent fuel be recovered, and since this recovery must be obtained at a low unit cost if economic nuclear power is to be achieved, the cost

of processing must be considered early in the conceptual design of the reactor. Accordingly, I was pleased to see that the organization of the program today is devoted to a discussion of the influence of chemical processing on the various phases of the design and operation of the nuclear reactor.

I was asked to speak on what the AEC expects of industry in the field of chemical processing. Perhaps this can best be done by discussing our plans for the future. However, in order to provide the entire group here with the previous background, I would first like to review with you the steps AEC has already taken in this phase of atomic energy.

Historically, the AEC has relied on American industry to carry out its research and development programs, engineering and construction, and operation of developmental and production facilities. Until recent years a considerable portion of our program has been devoted to military applications.

During the past few years the industrial application of atomic energy in the United States has grown steadily and rapidly, particularly in the building of nuclear reactors for research and the generation of electric power, and in the related supporting services such as fuel processing, fuel fabrication, and scrap processing. This same growth is also evident in other countries. The Commission has made available, over this period, the technology it has developed in these fields and has urged industry, whenever possible, to undertake the responsibility for the development and construction of the facilities for the peaceful application of atomic energy, especially in the field of nuclear power reactors. Industry, I believe, ahs responded admirably in spite of the many difficulties involved. Considerable progress, I believe, will continue to be made in this direction.

The Commission announced early in its civilian application program that it did not desire to provide supporting services to the nuclear power industry and that it would only do so until industry could provide these services at a cost which would not discourage the growth of nuclear power in the United States. It is gratifying to see that industry is responding in the fuel-processing, fabrication, and scrap-recovery operations.

It was recognized that getting industry interested in assuming responsibility for recovery of source and special nuclear materials from spent fuel elements would be a problem of a different order of magnitude. The Commission announced, in January 1956, a program to encourage private industry to build and operate chemical processing plants. We chose as the initial step a program of technical meetings which was directed toward providing industry, in a condensed form, the technology which was available to the AEC in the field of chemical processing. The papers presented at these technical meetings are available through our technical information service. The information presented at these meetings provided basic data necessary to those organizations who wished to make a more extensive study of chemical processing. More recently, the Commission presented a number of papers at a chemical processing symposium held in Belgium in May of this year. These papers are also available through our technical information service.

We also recognized that some form of direct AEC assistance might be necessary tc enable industry to build and operate private plants, for reasons such as the following:

(1) The fuel-processing load available initially may not be large enough;

(2) The fuel-processing technology has not been advanced to the desired stage of development;

(3) The design, composition, and quantities of the fuels to be processed have not been finally determined.

The Commission decided, in January 1956, to offer certain AEC irradiated fuels as a guaranteed base load for a private plant as a concrete item of assistance. This base load, which would be supplied under a contract with AEC for processing services, was intended to assure the processor of a reasonable load during the first years of plant operation.

FIRM CHARGES

During this period it became apparent that, before an industrial organization would be in a position to process spent fuels and to quote prices which would not discourage the growth of nuclear power, it would be necessary for the AEC to establish firm charges for this service. These charges were needed to allow firm planning by industry for the design, construction, operation, and financing of nuclear power reactors. Accordingly, the AEC set out to develop reasonable and consistent charges for such processing services.

On February 18 and March 12 of this year, the Commission announced that it would enter into contracts with private reactor operators to provide for processing of their irradiated fuels on the basis of firm charges, until such time as commercial facilities having the required processing capability become available. The AEC further stated that the contracts with the reactor operators would be canceled upon not less than 12 months' notice when it is determined that processing services will become available in commercial facilities at reasonable prices. A conceptual plant, capable of handling a variety of spent fuels, was selected as the basis for establishing charges for the AEC processing services. Because the Government does not incur certain costs normally experienced by industry, the Commission also decided at this time that prices in the order of 15 percent higher than the charges computed by the AEC would be considered reasonable prices to be charged by industry. I would like to mention here that the need for establishing charges and the bases for such charges were given the most searching consideration within the AEC. After a review of all the foreseeable ramifications, the Commission felt that the need for providing industry with processing charges was urgent and concluded that the AEC basis for the charges, as contained in the Federal Register notice of March 12, 1957, should be used. It was our feeling that reasonable charges must be made available if we are to bring into being a nuclear power industry. It was also the feeling that a commercial processor could meet the Commission's criteria of reasonable prices. It was recognized that this would be difficult and would likely involve some risk and small profit during the early years of operation.

Since our initial announcement of an AEC assistance program in January 1956 we had been studying the terms and conditions under which the AEC could accept proposals for processing services on the base load for a commercial plant.

AEC INVITATION OF APRIL 1957

In April of this year we decided to explore with industry their interest in constructing a plant to process fuels from licensed reactors with the assurance of a base load of AEC irradiated fuels. A number of companies interested in this field were requested to submit comments on a proposed invitation containing the terms and conditions under which the AEC would accept proposals for processing the base load. Many of you in the audience have replied to our request for comments on the draft invitation and I believe you will be interested, along with the others, in the general comments received from industry.

The proposed invitation for competitive proposals was generally unacceptable to the industry for a number of reasons, and no alternative bases acceptable to the AEC were included in the replies received. It was the consensus of the companies that the income from a plant, using the AEC definition of reasonable cost, would be insufficient to provide an acceptable return on the capital investment required. The unknown increase in development costs when fuels are changed to more competitive ones, the complexities of the storage and disposal problem, and the probable rapid obsolescense of some of the processes selected for the plant were some of the specific deterrents noted by the companies. The AEC does not wish to invite proposals from industry when there appears to be no reasonable chance that acceptable arrangements will result. Accordingly, the AEC does not intend to issue a formal invitation for proposals at this time.

Since industry appears unready at this time to undertake a major effort in the radiochemical processing of fuels from licensed reactors on the basis proposed, the AEC has been left with the problem of how to prepare for the processing of fuels returned from licensed reactors and to recover the valuable special nuclear materials, while still planning to have industry assume responsibility for processing private fuels at a later date. After a study of the possible alternatives, the AEC decided to process these fuels in existing developmental and production facilities for an interim period until industry builds plants for the recovery of source and special nuclear materials from licensed spent fuels.

As the processing load, the processing technology, and the composition of nuclear fuels become better known, we expect industry will begin processing the fuels from licensed reactors before the June 30, 1967, expiration date of our contracts with reactor operators. Our present plans do not contemplate processing these fuels in existing facilities beyond the expiration date of these contracts. Since it is our intention not to stay in this business, every effort will be made to minimize such modifications as will be necessary to these facilities, and to postpone actual expenditures of funds until the latest possible date, consistent with the need to keep recovery on a reasonable current basis. We do not consider the

use of existing AEC plants for performing the recovery services desirable over the long term. This plan has been selected with the confidence that the economics of chemical processing will change and that industry will build and operate processing plants in the near future. To support our objectives, as well as to provide the AEC with the data necessary to process these spent fuel elements on an interim basis, we will continue to direct our research and development effort toward both our immediate problem of modification of existing facilities and our longer-range interest in developing new, low-cost processing methods. We will also continue to direct our effort toward developing solutions to the waste storage and disposal problems.

While we do not at this time plan to issue an invitation offering specific AEC assistance in the form of a base load, I hope that it is clear to all that the way is open at any time for industry to build and operate a purely commercial processing facility, subject only to the Commission's licensing requirements. We are hopeful that some companies may find it attractive, perhaps as part of their development program, to undertake at least a limited effort in this field. A later AEC speaker, Mr. Manly, will comment on the subject of small processing plants.

In addition, we encourage you to discuss with us your views and comments on any aspect of this area of atomic-energy activity. These contacts will greatly assist us in our effort to arrive at a basis for industrial participation which will be acceptable to both the AEC and industry. We will give serious considerations to any basis for a proposal which you may suggest. We will again consider the offer of a base load, similar to the one previously made, when industry indicates that such assistance may result in satisfactory arrangements for the processing of private power fuels.

In its January 1956 announcement the AEC noted that Commission facilities may be utilized by private firms for research and development, and for training in connection with chemical processing. The full costs of such utilization would be defrayed by the user. I wish to call this to your attention, again, since no one has taken advantage of this offer. We feel that the work experience program, or training program, offers the fastest and least expensive way to train personnel and obtain up-to-date technology in this field. With respect to the technology of chemical processing, the developmental data being obtained at all of the AEC sites on the processing of private fuels will be made available through the technical information service.

Chairman DURHAM. This would give us an indication of what the concrete proposal was. On the matter of international cooperation, that is a matter that we have under consideration in another piece of legislation before the committee. You have been over there 5 or 6 times, and we were over there last fall for about 6 weeks and visited all of the plants of the NATO countries. I think some of the things you outline here are some of the difficulties that the committee saw last year with respect to developing atomic energy for peaceful purposes. I want to commend you for your thoughtful suggestions on this phase of the program.

Mr. SPECTOR. Thank you, sir.

Chairman DURHAM. I appreciate it very much.

Mr. Price, do you have any questions?

Representative PRICE. Mr. Spector, with what project is your firm identified at the present time, in the atomic-energy field?

Mr. SPECTOR. In the energy-power area, our main activities are connected with programs for the Consolidated Edison program at Indian Point. We are their engineers and consultants. We are also the engineers and prime contractors for the SEMIA power group in Italy for a similar station, but using pressurized water with uranium oxide fuel elements with the absence of thorium.

Representative PRICE. Is that strictly a private arrangement?

Mr. SPECTOR. That is a private arrangement as between Vitro and our client. The client is essentially Government controlled.

Representative PRICE. What sort of difficulties do you encounter in dealing with them?

Mr. SPECTOR. Our main unresolved problem in the contract is the question of our liability, sir. We have, in effect, postponed consideration of that problem by agreeing that we would continue for 1 year, during which time we hoped that legislation in Italy or some mechanism for handling this problem would come into being. We do not have an answer for that problem and fear that in the event that there is no answer within a reasonable period we might be willing to go along another year, but then we will be forced to reconsider our responsibility.

Representative PRICE. Do you have any dollar problems?

Mr. SPECTOR. We have not at the moment had any dollar problems, except that the group, in general, expects to get Export-Import Bank financing if they are to proceed. To this point this has not been a problem.

Representative PRICE. You are dealing with the Government over there?

Mr. SPECTOR. SEMIA is an operating entity of the Government agency for the operation of all their hydrocarbon and fuel resources.

Representative PRICE. You would not have the problem of inventory costs that you would have if you were dealing with one of their private utilities?

Mr. SPECTOR. It may be reasonable to assume that, but I can assure you that although they are a Government group, as I have described them, they are equally concerned and have indicated that they would like relief in this area.

Let me expand for a moment. The problem is that any group, be it Government or nongovernment, would like to show that they are embarked on a program that is producing electrical kilowatts at a reasonable cost. If they have to raise the money, this is one problem. If they have to assume that they will pay for this material and not just lease it for some period, then their costs actually go up. This is what concerns them most.

Representative PRICE. In dealing with a group that is under Government supervision, such as the group you are dealing with, would it be possible for them to have their fuel inventory on a lease basis rather than on an outright sale basis, as is the case with the private companies over there?

Mr. SPECTOR. This is what they would prefer, and I know of no reason why it should not be possible.

Representative PRICE. Is it possible now, under the manner in which we are handling this matter?

Mr. SPECTOR. I believe it would be. Under the bilateral, to my knowledge, this would be possible.

Representative PRICE. When you are dealing with a Government group?

Mr. SPECTOR. Yes, sir.

Representative PRICE. How far along are your arrangements with the Italian corporation?

Mr. SPECTOR. We have a contract with this group calling for our services and our responsibility over the entire duration of this project. This project is, itself, however, by instruction under this contract,

temporarily retarded in scope and in timing because of a certain amount of feeling on their part that they are not sure that they want to build an American station but, indeed, should perhaps build a British station instead.

Representative PRICE. Do they discuss with you what they might believe to be the advantage of dealing with the British rather than with you, an American outfit?

Mr. SPECTOR. They have, sir.

Representative PRICE. What do they intimate to you would be of advantage to them by dealing with the British?

Mr. SPECTOR. They have listed specifically two items, which are the ability to lease the fuel and a higher repurchase price for plutonium. They have indicated that both of these factors would, indeed, force them to review their now stated preferences for a British reactor.

Representative PRICE. So that the matter of leasing is also a problem with you, although you are dealing with a government group, the same as it is a problem as if you were dealing with private groups over there?

Mr. SPECTOR. Yes, sir. That is the point I have been trying to make.

Representative PRICE. Unless they can obtain this inventory on a lease basis, it appears now to be a very serious obstacle to our people doing business with foreign groups; is that correct?

Mr. SPECTOR. Yes, sir. We have very serious doubts that the project will go through as presently envisioned unless something is done along those lines.

Representative PRICE. With respect to the matter of indemnity, what are they doing to solve the indemnity problem? It looks to me as though that would be their problem, because we have taken care of the problem in this country on the matter of indemnity. This particular phase of the indemnity problem appears to be strictly a foreign problem.

Mr. SPECTOR. I agree with you, and we do not believe there is any solution unless they provide the basis for that solution in their own legislation.

Representative PRICE. Do they give any indication that they are considering it?

Mr. SPECTOR. They do, sir. They give indication that after the elections this matter will be one of the main matters receiving their consideration, along with general atomic-energy legislation, of which, of course, there is none at the moment.

Representative PRICE. If you get the indemnity out of the way and if the AEC over here agrees to a leasing arrangement with a foreign group, with respect to fuel for inventory particularly, then what remains in the way of obstacles to your doing business with foreign groups?

Mr. SPECTOR. I would say at that point we would be in very good shape.

Representative PRICE. That is all I have, Mr. Chairman.

Chairman DURHAM. You mentioned the matter of the repurchase of plutonium and the British pay more than we. Of course, we have been informed, and I believe correctly, at the present time British Government is only placing the value at $10 per gram for plutonium in comparison with our $12 before this change which has been suggested, so I do not see how they got that.

I think they told us about the same thing that you have outlined here with respect to some of the difficulties. They informed us about the political elections and things of that sort that were bothering them. They have to take care of these problems before they can attempt any legislation on atomic energy.

They do not have anything comparable with the AEC in this country and the British counterpart. They do not have any legislation on the books with respect to atomic energy matters. Is that correct?

Mr. SPECTOR. That is correct. We are surprised ourselves to find how quickly matters can move in the absence of such legislation. They have been handling it through what they consider the closest parallel they have in Italy, particularly, the groups that handle power in Italy. The have been quite successful in having the Edison project in Italy go forward to the point where they are about ready to start.

The British reactor contract itself has been hampered within the framework of that type of government approval.

Chairman DURHAM. The people we come in contact with, and those dealing with the problem, impress me that they were serious and very intense about going ahead with this program in every way they possibly could.

They indicated that the fuel cost and the length of time they would depend on us for fuel is the problem in Europe. That is the problem we have to face up to if we expect the reactors to be built in Europe. Mr. Hosmer?

Representative HOSMER. No questions, Mr. Chairman.

Chairman DURHAM. Thank you very much for your statement. Your letter to the committee on February 25 will be placed in the record without objection. You have no objection to it going in the record; do you?

Mr. SPECTOR. No, sir.

Chairman DURHAM. You are acquainted with that, are you not?

Mr. SPECTOR. Yes, sir.

(The letter is as follows:)

VITRO MINERALS CORP.,
New York, N. Y., February 25, 1958.

Hon. CARL T. DURHAM,
Chairman, Joint Committee on Atomic Energy,
Washington, D. C.

DEAR MR. CHAIRMAN: On behalf of Vitro Minerals Corp., I respectfully submit the following information pursuant to section 202 of the Atomic Energy Act of 1954. This information pertains to the uranium mining and milling problems in the State of Wyoming.

It is a matter of record that Vitro Minerals Corp., a Delaware corporation, with operating offices in Salt Lake City, Utah, and Riverton, Wyo., has done a large amonut of prospecting, drilling, and mining in Wyoming. The following figures summarize the extent of the Vitro effort and investment:

Holes drilled	3,404
Total feet drilled	444,395
Tons of ore mined	150,000
Direct drilling and acquisition cost	$833,300
Direct development and mining cost	1,887,000
Indirect expense	271,800
Cost of capital equipment	375,300
Total investment	3,367,400
Costs recovered through sale of ore	2,309,800
Unrecovered costs	1,057,600

The Vitro Minerals Corp. reserve figures in Wyoming are the following:

	Tons
Indicated and inferred	978,000
Potential	674,000
Total	1,652,000

Vitro Minerals Corp. owns or has leases on 207 claims, totaling 4,140 acres. Vitro has drilled only 49 of these claims, constituting 980 acres, which is approximately 24 percent of the total. Most of the drilling has been concentrated on five claims. Accordingly, the probability of additional ore discoveries is excellent.

Under the circumstances, the company has put more than $1 million into the mining effort in Wyoming with no return up to this time.

Vitro Minerals Corp. embarked on this program in Wyoming during the fall of 1954. All of the foregoing data are subject to verification by Government audit.

We need not, of course, remind that Joint Committee that the quest for domestic uranium sources has been a matter of paramount national necessity. Indeed, the announcement and repeated assertion of this strong policy objective by the Government have been the underlying reason which has encouraged the stockholders of Vitro Minerals Corp. to support the investment of their money in the extensive uranium program of the company in Wyoming.

The stockholders' outstanding and unrecovered investment of more than $1 million in Wyoming will be lost if this justly anticipated market for the ore is not now provided. For well over a year, Vitro Minerals Corp. has been negotiating with the United States Atomic Energy Commission for the purpose of finding a home for the Wyoming ore but the problem apparently is not one which can be solved by the Commission on its own initiative at this stage of development of the atomic-energy program.

When the United States Atomic Energy Commission was using every means at its command to expand the production of uranium in the free world, encouragement was also given to our Canadian neighbors. The Commission made a firm price offer for Canadian concentrate, and our Government has meticulously and properly lived up to that bargain.

It is also manifestly logical and proper that our Government take the necessary steps to safeguard the toil and diligence of its own citizens who responded to the call for effort to find and mine vitally needed uranium within our own borders. I would be derelict in my duty to the owners of our business if I did not urge upon you this course of action as strongly as I can.

Meanwhile, at best, in the face of the delays which are inevitable, interest on our indebtedness is accruing.

We are prepared to resume our negotiations for necessary milling capacity in Wyoming as soon as the Commission is in position to discuss the matter further with us. The Commission knows, of course, that we are most willing also to cooperate in the development of any program which is considered feasible to solve not only our own problems, but the problems of other miners as well in the Wyoming area.

Respectfully submitted.

J. CARLTON WARD, JR., *Chairman.*

Chairman DURHAM. The next witness is Mr. Leo Goodman, atomic energy adviser to the UAW.

STATEMENT OF LEO GOODMAN, ATOMIC ENERGY ADVISER, UAW

Mr. GOODMAN. Thank you, Mr. Chairman.

Chairman DURHAM. Mr. Goodman, we are very glad to have you with us.

Mr. GOODMAN. Thank you very much, Mr. Chairman. It is nice to be before this committee again.

My name is Leo Goodman. I am atomic energy adviser for the UAW, appearing here today in response to your invitation to Mr. Walter Reuther, who is unavoidably detained by union business in Detroit.

The committee knows from previous appearances, our organization has been interested in the development of atomic energy since the initial legislative hearings following World War II. The basic policy position of our union is adopted at the general convention, representing a million and a half members.

Prior to the adoption of the most recent resolution on atomic energy at the 16th constitutional convention, held April 7 to 12, 1957, our president, Walter Reuther, had filed with this committee a separate opinion as a member of the McKinney Panel on the Peaceful Uses of Atomic Energy.

The issues that have been made clear in the developments under the act since last year's hearings under section 202 were stated clearly in that separate opinion. They are—

1. The continued challenge of world leadership in the development of the peaceful atom.

2. The peaceful atom program in the United States continues to lag.

3. Nuclear power is essential to economic growth not only overseas but in sections of the United States today and in the future in many high-cost areas.

I have just returned from an extensive tour of six countries in Western Europe, where I met with representatives of trade unions, government, and industry. I was constantly under the obligation to explain to these many contacts why the United States continued to put is major emphasis upon the development of the military use of atomic energy while we increasingly fell behind weaker and poorer nations in the peaceful application of the atom.

There is a drive in Europe today toward the new, the modern, and the future. With the same kind of vigor which existed in the 13 States back in 1776, the Europeans are looking toward the future of the United States of Europe. They have already taken the first steps in the formation of a European Coal and Steel Community. They have signed agreements to establish a common market and Euratom.

Into each of these activities they are putting the vigor and the drive which we put into winning World War II.

I would like to say here, Mr. Chairman, that virtually every person that I talked to in Europe was hoping that the United States would join with them in applying the peaceful uses of atomic energy to the economic development of Europe.

They were hoping that we would maintain the kind of support that had been promised in President Eisenhower's speech. If we fail them, I believe there will be a tragic disillusionment in Europe.

Chairman DURHAM. They feel as though they had been promised something?

Mr. GOODMAN. Yes, sir; they certainly do, and the repetition of that promise, made on December 8, 1953, has convinced many of the Europeans that we intended to keep that promise long before now.

Walter Reuther, on returning from a similar trip, said:

> The first country that gives an atomic reactor to an underdeveloped country in Asia or Africa will win a psychological advantage that has as much power as an H-bomb (New York Times, September 21, 1955).

Shortly thereafter, Henry DeWolf Smyth, writing in Foreign Affairs, said:

> At present we are in a strong position to help foreign countries obtain nuclear power. However, if we are to make our atoms-for-peace program an effective part of our foreign policy we must realize we are in a highly competitive situation. Other countries have vigorous atomic energy programs. They have already proven their competence.

Chairman DURHAM. In other words, we are in competition with Russia?

Mr. GOODMAN. Yes, sir. Not only with Russia, however; we are also in competition with Great Britain and I believe we are now in competition with West Germany.

Gordon Dean had said:

> But let's face it, what they (foreign countries) want is atomic power, and American industry would like to supply the reactors to produce it. We are simply not implementing the President's atoms-for-peace proposal.

All of these warnings went unheeded because of the simple fact that we did not have an operating large-scale nuclear powerplant to show the foreign technician or customer. We could not sell our know-how because the proof of our capability was lacking.

In the separate opinion, Walter Reuther proposed that the best way to "get the job done" was to—

> achieve major technological breakthroughs in the construction and operation of full-scale demonstration power reactors, the fabrication of fuel elements and the reprocessing of spent fuels.

He questioned AEC policy of seeking to—

> achieve two purposes at once—to promote the development of nuclear power and to transfer to private enterprise a major part of the initiative and responsibility.

Henry DeWolf Smyth had said:

> Clearly the decisions as to what to build, where and how fast must be made by the United States Government. Only the Government can balance the importance of progress versus cost in terms of national prestige, foreign policy and long-range needs.

Dean said:

> People everywhere want cheap power. The atom gives promise of supplying it. And the United States has many times in the past 2 years promised assistance in this field, but we are not delivering on our promises.

What held us back? What prevented our taking the lead while we still had time? It was not our inability to build successful reactors because we did build the STR and the Nautilus reactors. We did build the APPR as a prototype for the construction of portable reactors for the DEW line.

We did design a reactor for a naval cruiser which was adapted into the construction of Shippingport. We do have a nuclear navy underway. But because we were told repeatedly by the Chairman of the AEC that we were not in a kilowatt race we do not have a family of civilian reactors which can compete with the Calder Hall design.

For a long period of time our AEC minimized the technical ability of the Soviet Union. Then offers of Soviet assistance in developing the atomic sciences spread first to the satellite countries, then to the neutral areas, and now we are facing Soviet offers to Western Europe.

In his separate opinion Reuther had said in connection with this economic penetration as part of the Soviet policy:

> Speed may prove to be the very essence of survival. The free world cannot win the cold war except as it succeeds in winning to freedom's side the vast majority of the uncommitted people of the world.

The record shows that the Russians have pledged development of atomic sciences in Indonesia, in Red China, in India, in Yugoslavia, in Egypt, and in Burma. While we continue to debate the false issue of public versus private development of nuclear technology in the United States, Soviet offers of economic assistance in the atomic field and others testify to the increasing emphasis that economic and scientific penetration is playing in the Soviet policy.

While the industrial world plunges ahead in this science we see the sad performance of industrial associations coming before you to seek amendment of the patent provisions, a provision of 5 years' compulsory licensing which has never been used and which may soon be of vital importance to the further development of controlled thermonuclear processes.

The Congress must look into the necessity of extending the compulsory period of the patent section 153 for at least another 10 years so as to protect the public interest in the development of controlled fusion.

It is unfortunate that the proponents of the private utilities have agitated opposition to nuclear power development among those engaged in the production of coal. Each source of energy, whether it be from fossil fuels, natural gas, or hydro or nuclear has its place in the development of our national industrial economy, and the errors of our atomic-power development are compounded when we confuse the necessity to develop all possible sources of energy with a temporary competition between them.

Those representatives of the coal-producing areas who voted against the bill to accelerate the civilian power-reactor program merely lent temporary aid and comfort to those overseas who would like to see the United States application of the peaceful atom lag behind.

Health and radiation hazard: Members of our organization continue their concern regarding the weaknesses which appear in the present organization of AEC regarding health problems due to potentials of radiation hazard. There are three major aspects of this problem.

One relates to site location of reactor installations. A close study of the Calder Hall project and the policy followed by the United Kingdom Atomic Energy Authority reveals continuation in that small country of the policy of remoteness as a factor in the choice of reactor sites.

A number of members of this committee—I believe, all those present today—have visited Calder Hall and Dounreay. I am sure that those of you who have lived through the experience of getting to these plants know how remote they are from population centers.

This is in sharp contrast with the policy which now prevails in this country. The present procedures provided in the law here are inadequate for the protection of the public interest. Some of the members of this committee protested the licensing of the PRDC reactor

even before the three intervening unions sought a review of the AEC decision.

The union petition for intervention was filed 19 months ago. The AEC has established a complex legal machine and process which has kept the plant under construction and the intervention under review ever since that time.

The Bulletin of Atomic Scientists said, this PRDC case "brings to light the multiple role played by the five-member AEC." The AEC is promoter, financier, partner, licensor, regulator, and party to the proceedings, all at the same time, and I might add judge and jury at the same time.

I hope the committee will once again take a look at the difficulties which this situation lends itself to. I believe that it is impossible for the same agency to properly perform all of these functions at the same time.

If this agency operated in a small segment of our economy the Congress might not find it worthwhile to separate the functions. But this agency is now a tremendous labyrinth. Its activities lead into every corner of the United States.

Its size can be indicated from the fact that it consumes between 8½ to 10 percent of all the electric power produced in the United States. It issues thousands of licenses. It controls, through access permits, and the power of classification, those who do business with it.

It makes grants to hundreds of colleges and frowns whenever anyone associated with the college joins in critically discussing the activities of the AEC in public.

The concentration of AEC's power can best be illustrated by its performance in regard to the second health hazard which this science presents. The Commission is properly encouraging the widespread use of radioisotopes. It is failing, however, to protect the public from the few radioisotope users who persistently violate its regulations.

One outstanding case which illustrates this failure involves the M. W. Kellogg Co. in Houston, Tex. Kellogg operated a plant to encapsulate cobalt 60 and iridium 192 for industrial radiography.

Mr. GOODMAN. The material involved in the instant case was iridium 192. That the material was lost is the essence of the accident. The encapsulated iridium vaporized into a dust which spread throughout the room because the hot cell was not enclosed.

Prior to reporting the accident the company applied for and secured a renewal of its license. The accident occurred on March 13, 1957. A renewal of the license was issued on April 2, 1957. The first report to this Joint Committee was dated April 30 but the license renewal No. 31–246–3 which according to section 13, "(This license) supersedes all authorizations issued to the M. W. Kellogg Co." was dated April 2, 1957.

Mr. Cook, the General Manager of AEC, advised this committee that the investigation of the accident was initiated on April 24 and "preliminary information indicates that at least one employe inhaled some radioactive powdered material."

I shall not review all of the details of this case but I would like to point out to the committee the very serious shortcomings of the AEC regulations covering this kind of case which made it possible for the AEC to suspend the license pending further order from the AEC.

A public hearing was called and the company was advised "that you may contest this order in a formal hearing if you desire."

Repeatedly the company was advised to enclose its hot cell. I understand that regulations require the enclosure of a hot cell of this type. The Commission license to Kellogg required that the company notify the AEC in the event of any accident.

I would like to insert into the record at this time a copy of the license granted to this company by the AEC on April 10, 1956. If I may suspend for a moment, I would like to show the members of the committee this license.

Please note on page 2, condition No. 14 which reads:

> Licensee will report to the Commission within 48 hours any incident which has resulted or could result in exposure to any individual in excess of a dose of 3 rem or any incident involving loss of licensed material.

Chairman DURHAM. Without objection it will be inserted in the record at this point.

(The license referred to follows:)

Form AEC-374
(6-56)

U. S. ATOMIC ENERGY COMMISSION
BYPRODUCT MATERIAL LICENSE

Pursuant to the Atomic Energy Act of 1954 and Title 10, Code of Federal Regulations, Chapter I, Part 30, Licensing of Byproduct Material, and in reliance on statements and representations heretofore made by the licensee, a license is hereby issued authorizing the licensee to receive, acquire, own, possess, transfer and import byproduct material listed below; and to use such byproduct material for the purpose(s) and at the place(s) designated below. This license shall be deemed to contain the conditions specified in Section 183 of the Atomic Energy Act of 1954, and is subject to all applicable rules, regulations, and orders of the Atomic Energy Commission now or hereafter in effect and to any conditions specified below.

Licensee	
1. Name: The M. W. Kellogg Company 711 Third Avenue	3. License number: 22-914-2
2. Address: New York 17, New York	4. Expiration date: April 30, 1959
	5. Reference No.

6. Byproduct material (element and mass number)	7. Chemical and/or physical form	8. Maximum amount of radioactivity which licensee may possess at any one time
A. Cobalt 60	A. Metal	A. 2,500 curies
B. Cesium 137	B. O.R.N.L. Sealed Sources	B. 2,000 curies
C. Iridium 192	C. Metal	C. 2,500 curies
D. Thulium 170	D. Sealed Sources	D. 100 curies

9. Authorized use

A. For encapsulation and redistribution to AEC licensed users.
B. For redistribution to AEC licensed users.
C. For encapsulation and redistribution to AEC licensed users.
D. For redistribution to AEC licensed users.

CONDITIONS

10. Unless otherwise specified, the authorized place of use is the licensee's address stated in Item 2 above.

11. Byproduct material to be used only at The M. W. Kellogg Company, Nuclear Products Division, Foot of Texas Avenue, South Houston, Texas.

12. Byproduct material to be used by, or under the supervision of, W. B. Converse, M. C. Yoder, or Jackson H. McVay.

13. THIS LICENSE SUPERSEDES ALL AUTHORIZATIONS ISSUED TO THE M. W. KELLOGG COMPANY.

14. Except as hereinafter provided the licensee shall comply with provisions of the Atomic Energy Commission's Standards for Protection Against Radiation as published in the Federal Register, January 29, 1957 (10 CFR 20).

15. Manufacturer's leak testing shall be carried out on all sealed sources; if delivery is not made within 6 months after successful completion of manufacturer's leak test, another test shall be performed not more than 6 months prior to delivery of the source.

(See Page 2)

For the U. S. Atomic Energy Commission

Date April 2, 1957 LDR by JCA/Jarrett

Director, Isotopes Extension
Division of Civilian Application
Oak Ridge, Tennessee

bc

Form AEC-374a (2-56)

U. S. ATOMIC ENERGY COMMISSION
BYPRODUCT MATERIAL LICENSE
Supplementary Sheet

Page 2 of 2 Pages

License Number 31-916-2

CONTINUED:

CONDITIONS

16. Leak testing of sealed sources containing beta and/or gamma emitting byproduct material, except those containing Iridium 192, Tantalum 182, and plated Cobalt 60 in discrete metallic form, shall be carried out at intervals of six months and records of the leak test results shall be furnished the Atomic Energy Commission upon request.

17. Each sealed source container (capsule) of licensed material to be used outside of a shielded exposure device shall have permanently attached to it a durable, legible and visible tag. The tag shall be attached directly to the container (capsule), or by the use of a durable chain or leader. The tag shall be at least one inch square and shall bear a radiation caution symbol in conventional colors, magenta or purple on a yellow background, and a minimum of the following instructions: "Danger - Radioactive Material - Do Not Handle - Notify Civil Authorities if Found".

18. A curie of Iridium 192 is defined as that quantity of activity which presents a radiation intensity of 0.55 roentgens per hour at a distance of one meter.

For the U. S. Atomic Energy Commission

Date April 2, 1957

by _____
Director, Isotopes Extension
Division of Civilian Application
Oak Ridge, Tennessee

Mr. GOODMAN. This was on May 2, 1957, and the Joint Committee was advised of a public hearing set for May 22. But on May 7 the company (by Mr. Voelker) wrote a letter to the Director of the Division of Civilian Application advising that he had consulted with Eugene Fowler, AEC staff employee who granted licenses acting for the Director of the Isotope Extension Division of Civilian Application of the AEC, and I quote:

For guidance in formulating this formal request for your reinstating our authorization for the use of encapsulated radioactive isotopes for weld radiographic inspection as a part of our separate authorizations for construction department activity.

On May 3, Mr. Northway, the manager of the plant, talked with reporters from the Houston Post. On May 15 a new application was filed. The mails must have worked very fast that day because the license was granted on the 17th of May.

It seems to me a slightly hasty action. This license contained the notation, "though it was granted on the 17th, that it was effective as of the 17th." Of course, the public hearing which had been set for May 22 was canceled.

It is clear, therefore, that the AEC who granted the license, suspended it, then collaborated with the company to avoid the necessity of a public hearing and reissued the license for a new location in Jersey City, N. J., which continues in effect today.

The reported increases in strontium 90 found in various sections of the world reemphasises, in connection with the third aspect of radiation hazard, the value of the hearings held during the past year on the Nature of Radioactive Fallout and Its Effect on Man.

Our members are increasingly concerned about the implications contained in the Joint Committee report of August 1957, which reads on page 3 that—

pending a resolution of differences it would appear from the information presented that the consequences of further testing over the next several generations at the level of testing of the past 5 years could constitute a hazard to the world's population.

We are happy to note that the committee has announced its intention to hold further hearings along this line, especially in regard to waste disposal. However, in view of the increasing number of radiation accidents and the inadequacy of the present regulations and procedures in the AEC, I urge this committee to include in its schedule this spring a hearing on the whole problem of radiation hazards to man from nonmiltary uses of the atom.

We cannot rely on the vagaries of local or State regulation, and it is clear that the AEC is determined to shift the responsibility for protecting the health and safety of the affected populations from radiation hazard to the States. The States do not have adequate staffs or funds to assume these functions and the recent offer of the AEC to train two inspectors for each State only proves the inadequacy of the State personnel to handle this problem at this time.

If the use of radiosotopes is bringing such tremendous benefits to industry as Dr. Libby is repeatedly stating, it is possible to spend the small sums that are needed to protect those handling the isotopes from the kind of accident which occurred in Houston.

I am reliably advised that the enclosure of the hot cell in that case would have cost between $1,200 and $2,400. A very small sum compared to the tremendous damage which was done by leaving the hot cell open.

The safety standards itself is open to question. I call the attention of the committee to the fact that the permissible occupational exposure level has been set by official bodies, ICRP and NCRP, at varying levels as follows: Prior to 1934—100 rems per year.

After extensive damage to laboratory technicians who suffered from that high level they reduced it to 60. In 1935–48 NCRP reduced it to 30. Between 1950 and 1956 it was reduced again to 15 by ICRP.

Now, there is a theoretical level set by ICRP of 5 rems per year. But in a recent speech in Paris, Dr. L. Taylor, Chief of Atomic and Radiation Physics at the Bureau of Standards, said:

> It may perhaps sound startling to contend that the establishment of permissible levels of radiation exposure is not basically a scientific problem. Indeed, it is more a matter of philosophy, of morality, and sheer wisdom.

When the trade union representatives met with him to discuss this "sheer wisdom" he talked about the cost to industry of lowering the maximum permissible limit. When it was lowered in the United States it was lowered more on a statistical averaging basis than in fact. Mr. Taylor revealed the reason for this in his Paris speech when he said:

> Consider the cost to plant operation if a legal limitation of 5 rems per year is put upon the individual worker. Plant management would be foolish to plan its operations in such a way that part of its workers would be allowed to take a dose closely approaching 5 rems per year.
>
> Experience has demonstrated that 1 or 2 people are bound to exceed this, and even though it is known that a slightly higher exposure is without harm, the employee might seek redress. Because of this fear, the plant must plan its operations so that, in general, no employee can receive more than say 40 or 50 percent of the permissable exposure. This could be very costly and could seriously retard the atomic energy industry.

This setting of working conditions by a physicist in the Bureau of Standards is an inadequate basis for law, regulation, and rule. Mr. Taylor is using his official position in the Bureau of Standards to advocate making these regulations part of the State law and local rule which covers the operation of the atomic industry.

If the setting of the standard is merely a matter of "sheer wisdom, philosophy, and morality," as Mr. Taylor says, that fact should be made clear to the American people, and affected workers should be given an opportunity to express their own judgment as to the adequacy of the "sheer wisdom" which has set the standard.

Many medical men challenge the basis upon which this standard was set. They do not believe sufficient research has been done to justify the figure which has been set as the "maximum permissible exposure" level. Mr. Taylor says in his Paris speech that the interpretation by other countries may differ.

I hope the committee will set hearings to find out "how" and "why." The committee in such a hearing should also consider the problem of protecting the victim of the inevitable accident. Present State laws are inadequate both as to medical care and workmen's compensation. It is possible that only a system of international safety standards, adopted through the IAEA, I hope, would provide a real-

istic system of regulations to offset the vagaries of weather which frequently are the determining factor as to potential damage.

An increased role for competent medical and public health bodies who are concerned with the health of each individual should be provided, and the Congress should seriously consider pending bills for the establishment of a National Institute of Radiological Health.

In conclusion, Mr. Chairman, I would like to quote the recent statement of Victor Reuther before the fifth national conference on economic and social development.

> **Unless the United States more vigorously applies its knowledge and know-how to the peaceful uses of the atom, the pledge and the hope of the atoms for peace program will fall flat. We can develop this science to bring benefits to even the most unskilled if we would apply our scientific know-how as vigorously to the peaceful use of the atom as we have to its military application.**
>
> **Imagine the great relief from the present tensions which could be brought to the arid and explosive Middle East if our existing technology were used to bring an increasing supply of fresh water by purification of sea water.**

Chairman DURHAM. Thank you very much, Mr. Goodman, for your statement.

Mr. Price, do you have any questions?

Representative PRICE. I would like to state to Mr. Goodman, since he has referred to the importance of study by the committee of the hazards involved on the part of the workmen in the atomic energy program, the Subcommittee on Research and Development has under consideration, has plans, as a matter of fact, to hold hearings very shortly on this subject.

It is one of the important items on the subcommittee agenda for the year and we hope to go into this very thoroughly, not only for the hazards involved, but to explore the problems of workers compensation in the event of injury as a result of work in this program.

Mr. GOODMAN. I am very happy to hear that.

Representative PRICE. We are also going into the enforcement of State laws to see how thoroughly informed the States are in this field and what work is being done at the State level to provide adequate protection to workmen in atomic projects.

We hope that your group will be in a position to testify and present material in evidence at those hearings.

Mr. GOODMAN. We would be very happy to do so and I commend you for planning to go into this subject.

Chairman DURHAM. Are there any further questions, Mr. Hosmer?

Representative HOSMER. Mr. Goodman, are you an outside consultant to UAW, or are you an employee?

Mr. GOODMAN. I am an employee, sir.

Representative HOSMER. Are there others on the staff working on this atomic advisory duty or are you the sole member?

Mr. GOODMAN. During the past year we have hired many consultants.

Representative HOSMER. You go outside and hire consultants?

Mr. GOODMAN. Yes. We have hired many nuclear engineers, scientists, and attorneys.

Representative HOSMER. You are the only staff member that deals with this?

Mr. GOODMAN. I am the only full-time staff member that deals with this.

Representative HOSMER. How long have you been the adviser?

Mr. GOODMAN. For 3 years.

Representative HOSMER. Were you in the atomic field before that?

Mr. GOODMAN. I have been involved in problems relating to the AEC for close to 10 years.

Representative HOSMER. Scientific problems or administrative and labor-relations problems?

Mr. GOODMAN. Both.

Representative HOSMER. That was in connection with a prior kind of duty you engaged in with the union?

Mr. GOODMAN. No. This was an assignment given to me in the union. I might say, Mr. Hosmer, that I read the very excellent summary you gave regarding your own background in joining this committee.

Representative HOSMER. I am a new member of this committee and I did not know your background.

Mr. GOODMAN. There was one brief omission which I would like to take the opportunity to acquaint you with. Apparently, in connection with the PRDC case, you were not aware or at least your report did not indicate, that prior to the intervention of the unions there was a report filed by the Advisory Committee on Reactor Safeguards upon which the union intervention was made.

I would like to hand you a copy of that report.

Representative HOSMER. I did not attempt to go into detail on that particular phase of it.

I think that is all.

Chairman DURHAM. Are there any further questions, Mr. Price?

Representative PRICE. I would like to state that I think one of the most significant paragraphs in your statement that I have always believed in the consideration of our power-development program is the statement that Dr. Smyth made many years ago and which you repeat in your statement on page 3.

He says—

> Clearly, decisions as to what to build, where and how fast, must be made by the United States Government. Only the Government can balance the importance of progress versus cost in terms of national prestige, foreign policy and long-range needs.

I have always subscribed to that statement on the part of Dr. Smyth and reread it occasionally. I hope we all reread it occasionally and attach the importance to it that we should. I feel that is in keeping with my feeling that we have not yet defined the real objective of our power-demonstration program.

Until we do, we are going to be faced with many problems that would tend to hold that program back. I think the one thing that we lack is a clear definition of our objective.

Mr. GOODMAN. I agree. One of the difficulties of the recent past has been the continued reiteration by the chairman of the AEC that we are not in a kilowatt race. I was very happy to hear Mr. Spector of the Vitro Corp. urge the adoption of a kilowatt goal because unless we set some goals that we will attempt to achieve, we do not have the drive and the force and the vigor in this phase of atomic-science development that we have had in other areas where I am sure we do set goals and we do apply our intelligence to achieve them.

Representative PRICE. That is all, Mr. Chairman.

Chairman DURHAM. As I understand your complaint about the Texas accident, Mr. Goodman, the complaint was primarily lodged against the lack of carrying out the regulations in the field. The law provides the necessary protection providing the regulations are enforced by the AEC and by whoever is operating the plant.

Mr. GOODMAN. That is correct. In this case not only was there failure to enforce the regulation, but it seemed to me that there was connivance between the company and the Commission to permit this company which has had a long history of violations of regulations—this and associated companies—to continue to operate without any accounting of why they failed to meet the requirements of the regulation.

I would like to point to the fact that this company which is a subsidiary of the Pullman Co. is also associated with the Keleket Co. which had an identical type accident in 1951 in Cincinnati, Ohio. There the building stands today as a grim reminder of the complete failure to enforce the regulations regarding radioactivity and the public-health officers in Cincinnati are refusing to permit the building to be used.

The company in that case has gone to seek insurance to protect themselves from the financial loss, but who is acting to protect the people who have been hurt in this case and in the Houston case, where there does not seem to be any desire of the AEC to protect those individuals?

Chairman DURHAM. Thank you very much, Mr. Goodman.

Mr. Toll, the staff counsel, has several statements here; and, without objection, they will be placed in the record.

Mr. TOLL. The committee has received the following letters and statements:

First, letter dated February 14, 1958, to Chairman Durham from Mr. Willis Gale, chairman of the Commonwealth Edison Co., forwarding a statement for the record:

DEAR CONGRESSMAN DURHAM: Enclosed is a statement to the Joint Committee on Atomic Energy which I am submitting in accordance with your invitation of January 20, 1958.

Along with the statement are 5 photographs showing the progress of our Dresden nuclear power station project.

The inclosures include 50 copies of the statement and 50 sets of the photographs. The glossy print sets of the latter are intended for members of the committee.

Sincerely yours,

WILLIS GALE, *Chairman.*

STATEMENT BY WILLIS GALE, CHAIRMAN, COMMONWEALTH EDISON CO.

I am pleased to have the opportunity to submit this statement to the Joint Committee on Atomic Energy.

My testimony will be in 2 sections The first part deals with the progress and details of Commonwealth Edison Co.'s Dresden nuclear-power project. The second part covers my views on acceleration of the country's atomic-power program.

We are glad we can report to the committee that our project currently is well ahead of our original schedule.

Based on information furnished to us by General Electric Co., the builder of the plant, we believe that Dresden nuclear-power station will be the first full-scale, privately financed atomic powerplant to come into operation in the United States.

Dresden's nuclear-power reactor is the largest under construction in the country. The plant's 180,000 kilowatts of electrical capacity is sufficient to serve a city of 250,000 population.

Our contract with General Electric calls for completion by December 7, 1960. We are confident it will be ready for operation by the middle of that year. The most recent schedule indicates that fuel will be put in the reactor in the latter part of 1959, leaving 6 months for preliminary tests.

As you know, we received on May 4, 1956, one of the first 2 construction permits issued by the AEC. As part of the requirements for an operating license, our report on the containment structure for the plant was filed last June. The Advisory Committee on Reactor Safeguards considered this subject in November. There have been no objections to the report and we anticipate early formal approval. The preliminary hazards summary, which contains the design information and description of the safety features of the plant, was filed with the Commission in September and we are awaiting advice from the Reactor Safeguards Committee.

Activity at the site 50 miles southwest of Chicago has been intensified since the start of major construction work last June.

The giant containment vessel, a 190-foot sphere built of 3,500 tons of heavy welded steel plate, is substantially completed. The construction will be climaxed in March when it will be sealed and tested to be sure it will withstand the design pressure of 29½ pounds per square inch. The purpose of the sphere is to contain any radioactive material in the remote possibility of a leak in the reactor assembly.

After the pressure testing is done, a hole will be cut through at ground level to permit moving in the reactor vessel and other equipment.

The next step will be the pouring of 22,000 cubic yards of concrete for foundations and shielding inside the sphere. The major part of the pouring will be done before the reactor vessel arrives this fall. The vessel is now being fabricated by New York Shipbuilding Corp. at Camden, N. J.

The reactor vessel, weighing 350 tons, is so massive it must be shipped by barge. It will be routed over the Atlantic and Gulf Intracoastal Waterways to New Orleans and then up the Mississippi and Illinois Waterways to the site.

The turbine building adjacent to the sphere is now closed in. The foundation for the turbine-generator has been completed. The condenser for the unit is scheduled to be delivered this spring and the turbine generator late next fall.

Meanwhile, fuel fabrication for the Dresden reactor core is underway. The Mallinckrodt Chemical Works at St. Louis has started converting uranium hexafloride from Oak Ridge into uranium dioxide powder. The powder is being shipped to General Electric at San Jose, Calif., where manufacturing of fuel pellets has started.

Before leaving the subject of Dresden it might be well for me to review some of the details of the project, including the financing.

Dresden will have a boiling water reactor. This is the principle developed and proved by the AEC's Argonne National Laboratory and expanded into the so-called dual cycle arrangement by General Electric Co.

Dresden is being built entirely with private funds. We are glad we were able to work out a plan to build our own plant without Government aid. However, as I shall explain later, we se no objection to Federal financial participation but, in fact, actually favor it.

Dresden is being built under a fixed price contract with General Electric for $45 million. It will be owned and operated directly by Commonwealth Edison.

Commonwealth will pay and capitalize as a regular part of its plant account $30 million of the contract price, plus something over $6 million of overhead and site costs.

The remaining $15 million of the contract price is being paid as a research and development expense over a period of 5 years by Commonwealth Edison and 7 other companies associated in nuclear power group. These companies are: American Gas & Electric Service Corp., Bechtel Corp., Central Illinois Light Co., Illinois Power Co., Kansas City Power & Light Co., Pacific Gas & Electric Co., and Union Electric Co.

On the basis of the costs of around $36 million which Commonwealth Edison will capitalize, we estimate that the total power cost, including fixed charges, operating expenses, and fuel, will ultimately approximate three-fourths of a cent per kilowatt-hour. This is about the same as the cost of power produced by our coal-fired units.

This does not mean that competitive nuclear power is here or just around the corner. Bear in mind that the three-fourths-of-a-cent figure does not take into account the $15 million of research and development expense. Neither does it take into account the probability that General Electric's cost of the plant will considerably exceed the $45 million contract price.

Despite these facts, we are optimistic about the long-run prospects for competitive nuclear power. We consider it a must for our industry to get into this field. We believe that our project has been soundly conceived and financed so as to burden neither our stockholders nor our customers. We are confident it will make an important contribution to the advancement of the art of generating electricity.

The only way our country can achieve competitive nuclear power is through the building of a series of full-scale model T's like Dresden. This process will bring gradual improvement in our technology.

Nuclear power will become competitive first in those parts of the world where power costs are high due to scarcity of fossil fuels or lack of hydro sources. Likewise, it will become competitive first in high-cost areas in the United States.

That completes the first part of my testimony. I would now like to direct my remarks to the subject of our country's atomic power program.

From the point of view of economics alone, atomic power in this country should be permitted to find its place in our economy in a process of normal and logical development. However, with the progress which is being and will be made in the rest of the world, where fossil fuel is scarce and expensive, it is doubtful if a normal, orderly development here is practical. The American people are not likely to be satisfied to have other parts of the world ahead of us in this important field.

Everything considered, it appears that our atomic power program in this country must be accelerated beyond the ability of private industry to carry the entire burden.

There are many shades of opinion on this subject. I won't go into detail about these philosophies. But I would like to tell you how we at Commonwealth Edison feel about it.

We advocate certain basic steps. These include:

1. That there be the maximum practical participation by existing utilities, coupled with a substantially expanded program of cost sharing by the Federal Government.

2. That authority be given the AEC to make substantial outright cash contributions toward the capital cost of power reactors in addition to the existing research and fuel allowances.

3. That these atomic plants be built and owned by existing utilities, which would be required to put into their projects the full amount justified by competitive power costs.

4. That the Federal Government pay a substantial part, but not all, of the balance.

5. That projects be approved for both privately and publicly owned utilities.

6. That the amount of the Federal aid be split between the two roughly on the basis of the present amount of private power as compared with the present amount of public power in the country. This should entirely eliminate from our atomic program the question of public versus private power.

It seems to us that the country will go faster and further—and at less cost—along the road to competitive nuclear power by utilizing the know-how of existing utilities.

If these utilities pay a substantial part of the cost it will not only reduce the drain on the Federal Treasury; their participation will also give the utilities the experience of building and operating nuclear plants.

The United States will not have a truly competitive nuclear power industry until the utilities, after careful study of relative costs, walk up to the counter and buy nuclear plants as a strictly business matter. Only actual experience in building and operating reactors can provide the basis for these decisions.

Mr. TOLL. Second: Statement by Mr. R. L. Schacht, general manager of the Consumers Public Power District.

STATEMENT BY R. L. SCHACHT, GENERAL MANAGER, CONSUMERS PUBLIC POWER DISTRICT

My name is R. L. Schacht. I am general manager of Consumers Public Power District of Nebraska.

Since submitting a proposal for the PWR in early 1954, we have appeared before various committees of the Joint Committee to describe Consumers Public Power District's participation in the atomic energy program. On June 12 of last year, we testified before this subcommittee and outlined our organization's background as an electric utility, as well as to describe negotiations with the Atomic Energy Commission for participation in the power reactor demonstration program. Inasmuch as this background information is a part of the record of the Joint Committee, I shall confine my present remarks to our activities which have occurred since June 12, 1957.

In the latter part of August, during the closing days of the 85th Congress, Public Law 162 was passed authorizing the appropriation of AEC funds. As a part of this law, funds were authorized for the sodium graphite reactor project proposed by Consumers. This authorizing legislation did not specify any special requirements for contracting by the Atomic Energy Commission with Consumers Public Power District, and the Atomic Energy Commission and Consumers' staff proceeded to convert the previously established contracting principles in a contract draft.

On September 13, these contracting principles were laid before the Joint Committee by the Atomic Energy Commission and Consumers, and a request was made to waive the 45-day waiting period required under section 111b of Public Law 162. After the committee staff polled individual members of the committee, this waiver was granted and the Atomic Energy Commission and Consumers' staff completed a series of negotiations with a final contract draft. In addition, the Atomic Energy Commission received a satisfactory answer from the Comptroller General regarding the Commission's authority to enter into the contract with Consumers District. One week after requesting the waiver from the Joint Committee, the contract was signed and the following day Consumers informed the turbine manufacturer that the turbogenerator equipment, ordered in March of 1957, was to be designed for steam conditions of the reactor system.

During the first week in October, meetings were held with the Atomic Energy Commission, Consumers Public Power District and Atomics International personnel to establish the methods of coordinating the work of this project to establish the division of responsibilities, methods of communication, etc. This initial meeting has been followed by a series of technical sessions. From the success of these meetings, it would appear that we have established an effective method of operation between Atomics International with responsibility for reactor design, Consumers District which has the responsibility for the nonreactor facilities and the Atomic Energy Commission.

Preliminary engineering on the reactor portion of the plant was started in November of 1957, and will continue until the start of final design in August of 1958. Research and development activities required for those components which are new to reactor application are now underway and by June of 1958 prototypes of some experimental pieces of equipment will be ordered. This prototype program will include further studies of liquid-metal pumps, heat exchangers and steam generators. Reactor construction is scheduled to begin in March 1960, with completion of construction in the last half of 1961. The startup operations, which are scheduled to begin in November of 1961, will be preceded by a period of system checkout, operator training, and interconnection with the conventional facilities.

The preparation of specifications and design criteria for all phases of the fossil-fueled boiler, turbogenerator, associated electrical equipment and buildings (conventional facilities) has been under way since the fall of last year.

In accordance with the turbine and fossil-fuel boiler contracts which have been awarded, detailed engineering and drafting for these components is progressing. In addition, detailed engineering and drafting is under way for the site layout and preparation, substructures, buildings and power piping required for these conventional facilities. The site preparation work will be started during the coming summer and major construction of the conventional facilities will be started in 1959.

At the present time, Consumers District is reinvestigating its schedule for installation of conventional facilities. In all probability, completion of construction will be delayed for approximately 1 year so that initial operation will

begin in the spring of 1961 rather than in the spring of 1960. This will, in no way, alter our objective of having the conventional facilities ready for operation in time to meet the completion date of the reactor construction. Consumers District's original decision to install the conventional facilities for operation in 1960 was dictated by Nebraska's need for power in the summer of that year. General rainfall in the Missouri River Basin has resulted in additional availability of summer firm power from this source, and has suggested the possibility of a delay of 1 year in the initial operation of the conventional facilities.

Consumers District is continuing to investigate the feasibility of utilizing this reactor as a dual-purpose reactor to the extent that the radioactive sodium in the primary coolant can be used as a radiation source in the processing of foods, chemicals, etc. This capability is unique to the liquid metal coolant systems.

In any radiation processing program, the amount of shielding, conveyor equipment and handling facilities will be essentially the same regardless of the source of radiation. In making an economic comparison of various radiation facilities proposals, the success or failure may hinge upon the cost of the radiation source and the location of the source. In the Nebraska program, the source of radiation appears as essentially a no-cot byproduct of the fundamental objective of power production. In addition, being located near the center of the food-producing area of the country makes this dual purpose approach seem even more attractive. If we can prove the feasibility of this dual capability, the results should be of considerable interest both to this country's domestic and foreign programs.

I believe we have an excellent basis for proceeding with this program, and there should be no delays in the schedule outlined to you by the Commission staff and in this statement. I am optimistic that the inherent advantages of the sodium graphite reactor will be realized.

Mr. TOLL. Third: Letter to Chairman Durham, dated February 20, 1958, from William Webster, president of Yankee Atomic Electric Co.

Hon. CARL T. DURHAM,
Chairman, Joint Committee on Atomic Energy,
Washington, D. C.

DEAR MR. DURHAM: Your letter of January 20 very kindly invites me to submit a statement to be included in the record of the Joint Committee's annual hearings under section 202 of the Atomic Energy Act. Carrying forward the pattern of prior years, I should like to take this opportunity to make a current report on the nuclear power project being carried out by Yankee Atomic Electric Co.

The background and development of the Yankee project has been outlined in my earlier statements to the committee, both in the section 202 hearings of prior years and, more recently, in a statement before the Subcommittee on Legislation on June 25, 1957, in connection with hearings on appropriation authorizations.

Briefly, Yankee is a Massachusetts electric company whose stockholders are 11 New England utility companies supplying over five-sixths of the electrical requirements of our six-State region. (Two of the original stockholders, the Hartford Electric Light Co. and the Connecticut Power Co., were merged as of January 1, 1958.)

Yankee has undertaken the construction and operation of a 134,000-kilowatt nuclear powerplant using a pressurized water-type reactor with stainless steel fuel elements containing uranium oxide in pellet form. The plant will be located at Rowe, Mass., on the Deerfield River and its entire electrical output will be purchased by Yankee's utility stockholders.

The Yankee project is one of the first-round projects included in the Atomic Energy Commission's power demonstration reactor program and the Yankee research and development assistance contract with the Commission was the first to be entered into under that program. The research and development program contemplated by the assistance contract is being carried out by Westinghouse Electric Corp. and construction of the plant will be carried out by Westinghouse and Stone & Webster Engineering Corp. as joint contractors for Yankee.

During the past year several mileposts have been passed.

The research and development program which commenced in 1956 is now approximately at the halfway point. This program has already provided the basic data necessary for the design of the plant, nuclear core and control systems. Emphasis in the future will be placed primarily on evaluation and possible

improvement of the core design. Test fuel elements have been fabricated and critical experiments have been commenced in Westinghouse's new test facility. In addition, work has commenced on fabricating the test equipment necessary for radiation damage experiments to be conducted at the materials testing reactor commencing in the latter part of the year.

Construction work commenced late last year upon issuance by the Atomic Energy Commission of a provisional construction permit dated November 4, 1957. This was the first major construction permit issued by the Commission after the 1957 amendments to sections 182 and 189 of the act, requiring a preliminary report of the Advisory Committee on Reactor Safeguards and a public hearing. The permit requires Yankee to submit satisfactory evidence of its financial resources within a year.

A construction contract was executed with Westinghouse Electric Corp. and Stone & Webster Engineering Corp. on November 15, 1957. Prior to that date, engineering designs had been carried well along and orders had been placed for all long-delivery items of equipment. Major construction work will commence this spring. Present construction schedules call for completion of the plant and installation of the initial core during the latter part of 1960.

Incident to the execution of the construction contract, a detailed cost estimate was developed, indicating total capital requirements for the project, including construction costs and allowances for working capital and the cost of the initial core, of $57 million. After preliminary conferences with the Securities and Exchange Commission, which exercises jurisdiction over Yankee's financing arrangements under the Public Utility Holding Company Act of 1935, Yankee has arranged for the placement of senior securities which will provide permanent financing of its estimated capital requirements on substantially the following basis:

5 percent first mortgage bonds	$20,000,000
4¾ percent unsecured notes	17,000,000
Capital stock (to be held by Yankee's utility stockholders)	20,000,000
Total	57,000,000

The details of this financing are now being arranged, following which applications will be filed for necessary regulatory approvals. The various interested regulatory commissions, which include the New England public utilities commissions, the Securities and Exchange Commission, and the Federal Power Commission, in addition to the Atomic Energy Commission, are kept currently informed of the progress of the Yankee project.

Passage of the Price-Anderson bill at the close of the last session of Congress and the availability of nuclear insurance through the recently formed private insurance pools removed a major obstacle to going forward with the project and obtaining permanent financing for the capital requirements involved. The present status of the project is such that none of the rather formidable engineering and operating problems that lie ahead seems apt to present an insurmountable hurdle to the successful completion of the plant. With reasonably good luck we hope to be able to meet our rather tight present construction schedule and to have the plant in limited operation in late 1960.

Yours very truly,

WILLIAM WEBSTER, *President.*

Mr. TOLL. Fourth: Letter dated January 27, 1958, from Irwin L. Moore, president of New England Electric System:

DEAR CONGRESSMAN DURHAM: Thank you for your letter of January 20 and for your invitation to express our views before your committee on the various problems affecting our activities in the atomic energy field.

New England Electric System has taken an active interest in the development of electricity from atomic energy since Congress first permitted private enterprise to enter this field. Specifically, our activities have been proceeding along two lines.

Our first and more immedite interest in the atomic energy field is in Yankee Atomic Electric Co., in the formation of which we took a leading part nd in which our subsidiary, New England Power Co., holds a 30 percent interest. Excellent progress is being made in all phases of this major demonstration project, which is presently scheduled to be in operation during 1960 barring unforeseen delays. A more detailed and comprehensive report on the progress

of this project will be made to your committee directly by Yankee Atomic Electric Co., of which our executive vice president, Mr. William Webster, is president.

Second, the New England Electric System's directors have authorized construction of a large atomic powerplant to be added to our system in the mid-1960's. Our long-range power supply and transmission planning includes the contemplated construction of such a plant in the hope and expectation that such a plant will be able to assume very nearly a competitive role versus conventional plants by that time. Meanwhile, we are proceeding with the selection of a site and are following the progress of reactor development so as to be in a position to select the most suitable type and most appropriate contractor by approximately 1960.

The exact timing of this larger plant will, of course, be governed by the rate of growth of our load and the size of the conventional additions to our power system that are scheduled to come onto the line in the early 1960's. We do not anticipate that this timing will be significantly affected by concern over the technological progress of the art or the economic outlook as we now see it.

Sincerely yours,

IRWIN L. MOORE.

Mr. TOLL. Fifth: Statement submitted by Power Reactor Development Co.:

INTRODUCTION

This statement is submitted by Power Reactor Development Co. (PRDC) for inclusion in the record of the hearings being held by the Joint Committee on Atomic Energy during the 2d session of the 85th Congress pursuant to section 202 of the Atomic Energy Act.

PRDC is a nonprofit Michigan corporation, and is engaged in the design and construction of, and will operate, a developmental fast neutron power breeder reactor at Lagoona Beach, Monroe County, Mich.

The Detroit Edison Co. is building and will own and operate conventional steam turbine-generator facilities adjacent to the reactor and will pay PRDC for steam produced by the reactor.

Atomic Power Development Associates, Inc. (APDA), a nonprofit New York membership corporation, is conducting important programs of research and development in connection with the project, which include the purchase, erection, and operation of a major component test facility comprising several full-size components of the reactor.

The project was undertaken in response to the power demonstration reactor program of the Atomic Energy Commission. The reactor and conventional generator facilities together are known as the Enrico Fermi atomic powerplant. The plant will have a rated capacity of 100,000 kilowatts (electricity) and 300,000 kilowatts (heat); however, higher capacity auxiliaries are being installed to accommodate possible increases in overall capacity at a later stage of operation.

The members of PRDC, all of whom are utility or industrial companies, are listed on page 402 of part I of the section 202 hearings held in February, 1957.

POWER DEMONSTRATION REACTOR PROGRAM CONTRACT BETWEEN PRDC AND ATOMIC ENERGY COMMISSION

PRDC and the Atomic Energy Commission have executed a contract under the power demonstration reactor program, effective as of January 1, 1957. The contract provides that PRDC will build, own, and operate the reactor at its own expense and will furnish to the Commission all research, technical, and operating data from the project, as long as it is operated. The contract further provides for certain research assistance to PRDC by the Commission not to exceed $4,450,000, and for a waiver of use charges for special nuclear material for a period ending 5 years after issuance of a facility license.

The Office of the Comptroller General made a review of the contract, and its report was transmitted to Congress on August 9, 1957. The report concluded that the contract is within the authority of the Commission and in accordance with the purposes of the power demonstration reactor program. The report also noted that under the contract the Atomic Energy Commission has broad rights for examining and studying the technical aspects of the work, and an adequate basis for ascertaining the accuracy of cost data submitted. The contract pro-

vides for the examination of the books and records of PRDC, of APDA records of work on the project, and of the direct costs of the Detroit Edison Co. in connection with the conventional turbine electric generating facilities.

Since the execution of the contract, PRDC and the contract administration personnel of the Commission have been working closely to implement its provisions. PRDC is submitting reports on a regular basis, pursuant to the provisions of the contract, to the Chicago Operations Office of the Atomic Energy Commission. PRDC has a satisfactory working relationship with the contract personnel of the Commission at the Chicago Operations Office in the implementation of the contract.

STATUS OF RESEARCH AND DEVELOPMENT

During the past year, the research and development phases of the project have proceeded very well. This work is going forward simultaneously with completion of design and with construction. PRDC has expended $228,936 on research and development, of which it expended $216,000 in 1957. APDA, which has expended $9,364,832 to date, expended $2,300,000 of that amount in 1957. (See schedule 1, attached hereto.)

During the year, the study of reactor physics and control by simulation techniques was continued. PRDC has an extensive program of simulator studies in which mathematical models of the reactor and various operating conditions are simulated on analog computers. This is a very valuable and useful program, and the results of these studies are being incorporated in the design of various components of the reactor and in control systems.

Consultants of PRDC, including personnel of the University of Michigan, are continuing to make studies of the environmental characteristics of the site, and information being derived from these studies is being integrated into the design of the various facilities. The weather tower has now been operating since June 1956. The preoperational radiological background survey has been initiated and will provide in excess of 2 years' data on the radiological background of the area prior to operation of the reactor.

Research in connection with the fuel has included the continuation and expansion of a program of irradiation of fuel-element samples, and PRDC expects shortly to begin irradiation of samples in the sodium reactor experiment (SRE) which is operated by Atomics International. The fuel material has proven to be satisfactory under the irradiation tests thus far completed. By August of this year, a critical experiment should be initiated in the zero power reactor III (ZPR–III) which is located at Arco, Idaho, and is operated by the Argonne National Laboratory. This experiment will permit verification of calculations as to critical mass, control-rod worth, and other nuclear parameters.

PRDC and APDA have followed with great interest the progress of the fast reactor program of the Commission, and appreciate very much indeed the cooperation of the various Commission laboratories. PRDC has been particularly interested in the redesign of the EBR–I core and in the renewed operation of that reactor which began in November 1957. Analyses by PRDC's consultants to the causes of the damage to the EBR–I mark II core in November 1955, in common with analyses made by others, indicated that the mechanical design of that core, which permitted fuel-element bowing, caused the prompt positive power coefficient which resulted during the experiment in the overheating and partial melting of the core. The redesigned core, mark III, eliminates the possibility of mechanical bowing, and PRDC was extremely gratified to learn recently from Dr. Norman Hilberry, Director of the Argonne National Laboratory, that the preliminary conclusions from the initial experiments, including operation to approximately 50 percent of power at full to one-third flow conditions, have indicated that these theoretical conclusions are correct. Dr. Hilberry advised PRDC that both the isothermal temperature coefficient and the steady state power coefficient of the reactor are negative; that the new rigid core appears to have eliminated the prompt positive power coefficient which was observed in the earlier EBR–I core; and that the prompt as well as the steady state coefficientsa ppear to be negative. He also advised that oscillator studies of the reactor response under severe power-to-coolant flow ratio conditions show the reactor to be very stable.

APDA engineers currently assisting in the conduct of the EBR–I test program have also advised that the use of the oscillator technique at low reactor power levels during the preliminary tests has proved to be effective in predicting reactor behavior at higher power levels. This is a technique which is proposed

to be used in initial nuclear testing of the Enrico Fermi plant and on which a great deal of preliminary work has been done. There has never been any question of the safety of property conducted oscillator tests, and it is gratifying to obtain further experimental verification that the information which is derived from such tests is reliable. This technique will undoubtedly prove to be a valuable one with respect to the technology of all reactor types. PRDC will continue to follow these experiments with interest.

PRDC has also continued studies related to postulated overheating and melting of fuel elements, both in the presence and absence of sodium coolant. Several experiments have been completed and more are projected for the near future. In addition, research on other aspects of the project has continued. During the year APDA satisfactorily concluded 15 months of continuous operation of a test steam generator unit, and a new unit is now being erected for further testing.

STATUS OF ENGINEERING, PROCUREMENT, AND CONSTRUCTION

There are approximately 200 engineers engaged full time on various phases of the project—by APDA, which is serving research, development, and nuclear design functions; Commonwealth Associates, Inc., the architect-engineer; and United Engineers & Constructors, Inc., the construction engineer. In addition, a large number of engineers engaged by suppliers of components are working in connection with the completion of shop fabrication drawings and overseeing construction progress. Specifications for the fuel and blanket elements have been prepared by APDA and have been sent to 11 prospective bidders. Seven of these companies have indicated an intent to bid and are now preparing their proposals, which will be submitted to PRDC by March 1. These proposals will cover the fabrication of sufficient fuel for the first 2 years of operation. Specifications have also been prepared by APDA for the steam generators, and 5 suppliers have indicated their intention to submit bids covering the fabrication of the steam generators. These responses are also expected by March 1. Sodium pumps and intermediate heat exchangers have been ordered and are being fabricated. They will be shipped to the plant this year for installation prior to the nonnuclear test facility operation.

Construction of plant structures has been underway since August 8, 1956. Development of the site and erection of a weather tower preceded this by approximately 4 months. The construction and nonnuclear test of the reactor and associated generating facilities were originally scheduled to be completed in December 1959. Recent studies of this construction schedule have indicated the necessity for a stretchout of the schedule of about 8 months. This is due primarily to a delay in the delivery of the reactor vessel—one of the major components of the reactor part of the plant. The vessel is now scheduled to be shipped in March of 1958. As a result of this delay, the construction schedule has been reviewed, and the new estimated completion date is August 31, 1960, after which will follow a 1-year period of low-to-full-power nuclear testing. While it is impossible to predict with certitude the accuracy of a construction schedule for a project such as this, in developing the new schedule PRDC had available considerably more experience with respect to the fabrication of components, and it has taken into consideration possible delays in the manufacture of other unique items of equipment. It is believed that the present schedule is a realistic one.

Significant progress has been made during the past year in the construction phase of the project. Figures 1 and 2 provide a photographic comparison of the construction status at the site a year ago with that of today.

Since last year when preliminary foundation work had been completed, the steel reactor containment building, 120 feet high and 72 feet in diameter, which will house the major reactor components and all systems subject to radioactivity, has been completely erected and successfully pressure tested at 40 pounds per square inch in accordance with the ASME Code. Both the large 150-ton rotating building crane and a smaller 25-ton crane have been installed in the containment building and are now being used in the placing of component parts in position. Figure 3 is a paragraph taken inside the containment building. It shows foundation concrete for the reactor components complete, the lower section of the primary shield tank in place, and shield wall columns erected.

The containment building is prepared for delivery of the reactor vessel, which is scheduled to be shipped from the Chattanooga, Tenn., plant of the fabricator, Combustion Engineering, Inc., in March. The vessel, which is shown in

the photograph, figure 4, will initially be owned by APDA and be used in the component test facility. The shipment of this 100-ton, 38-feet high, and 14-feet diameter stainless-steel vessel has presented complex and unique shipping problems. These have now been resolved by the construction of a special railroad car which will be taken over a carefully selected route which has been checked and cleared of interference. In addition, temporary trestles have been erected at the site and a temporary opening has been cut in the building to facilitate placing of the vessel, which is the largest component in the plant. The photograph, figure 2, shows the sodium storage building now under construction. This heavily shielded building, which has steel-lined internal walls, will be used to store radioactive sodium and will also house the sodium purification equipment. The sodium building and its sodium system piping will be completed for the nonnuclear test program which will be conducted by APDA during 1959.

As set out more fully in the separate statement submitted by the Detroit Edison Co., that company has completed the construction of an elevated water tank which will provide potable water for the plant and storage water for the condensate system. The Detroit Edison Co. has also constructed a sewage plant and a service building, which are also shown in the photograph figure 2. This service building will house potable water treatment equipment and an oilfired heating boiler which will serve the entire plant.

PROJECT EXPENDITURES TO DATE

Schedule 1 attached to this statement provides a breakdown of expenditures in connection with the PRDC project through December 31, 1957, by PRDC, APDA, and the Detroit Edison Co. These 3 organizations have actually expended a total of over $15,500,000, of which approximately $7 million was spent during 1957 and the remainder in 1956 and earlier years. The Detroit Edison Co. has spent a total of approximately $1,700,000 on the nonnuclear portion of the plant; PRDC and APDA together have spent some $4,460,000 for equipment and construction on the nuclear portion of the plant, and some $9,600,000 on preliminary design, research, and development work.

ESTIMATED PROJECT COST SUMMARY

The presently projected overall costs of research, development, and construction of the Enrico Fermi plant, including $3,702,600 for the estimated value of "use charges" to be waived during both construction and operation but excluding PRDC's allowance of $1,175,000 for working capital, total $75,298,432. These cost estimates are broken down in greater detail in schedule 2, attached to this statement.

NONNUCLEAR PORTION OF PLANT

The Detroit Edison Co., which has contracted with PRDC to build, own, and operate the nonnuclear conventional turbine-generator facilities, is filing a statement for the record of these section 202 hearings. The attention of the committee is directed to that statement for information regarding the nonnuclear portion of the plant.

NUCLEAR PORTION OF PLANT

Total estimated plant costs for the reactor and associated facilities are $34,850,000. To this must be added PRDC's estimated administrative and overhead expenses during construction of $2,170,000, giving a total cost estimate for the reactor portion of the plant, not including any allowance for working capital, of $37,020,000. See schedule 2.

The figure of $34,850,000 for plant costs corresponds with the figure of $31,225,000 previously reported to the Joint Committee. See hearings before the Subcommittee on Legislation of the Joint Committee on Atomic Energy on authorizing legislation for fiscal year 1958, 85th Congress, 1st session (1957), pp. 146–47, 443. The previous decision made in the latter part of 1957 to stretch out the construction schedule for an additional 8 months has necessarily resulted in certain additional plant costs, principally interest and taxes. With these adjustments, the original plant cost estimate of $31,225,000 became $31,675,000. Cost experience gained on both construction work and the purchase of components during the past year indicated that actual costs on these items were running somewhat less than 10 percent over the detailed construction cost estimates of December 1956 In line with this experience, therefore, the esti-

mated plant cost figure of $31,675,000 for the present construction schedule has been increased by approximately 10 percent or $3,175,000, to give an overall cost estimate of $34,850,000.

The administrative and overhead expense item of $2,170,000 (schedule 2) similarly corresponds with a previously estimated figure of $1,816,000. This increase results largely from the stretched out construction schedule. Thus the estimated costs for the nuclear portion of the plant now total $37,020,000, not including PRDC's allowance of $1,175,000 for working capital. (The figure of $43,216,000 given in PRDC's statement in the 1957 sec. 202 hearings (p. 399) included an allowance of $9 million for research and development expenditures by PRDC and APDA and $1,175,000 for working capital for PRDC. The corresponding total figure on the basis of present estimates, giving effect to the same adjustments for R. & D. expenses and working capital, would be $47,195,000.)

As noted above bids covering the fabrication of fuel and blanket elements as well as steam generators are due March 1, 1958. In addition, specifications covering the reactivity oscillator and sodium pipe shielding are being prepared, and bids will be sought shortly. With this additional experience in hand, it is anticipated that PRDC's construction cost estimates will be further revised in detail.

RESEARCH AND DEVELOPMENT

During the period 1952 through 1956, APDA and predecessor organizations expended a total of $7,064,832 on research and development, preliminary design work and associated overhead and administrative expenses. In 1956 PRDC similarly spent $12,936 on research and development. For the period 1957 through 1960 APDA has agreed to furnish to PRDC additional research and development work, which PRDC has valued at $4 million, and PRDC itself has budgeted a total of $5 million of such expenditures for the full construction and test period. Total research and development expenses of PRDC and APDA combined attributable to the project will thus total over $16 million. In addition, PRDC's contract with the Commission, effective January 1, 1957, calls for up to $4,450,000 of research and development work to be performed in Commission facilities. When this is taken into account, total estimated research and development work in connection with the project comes to at least $20,514,832.

AMOUNT OF USE CHARGES TO BE WAIVED

PRDC's contract with the Commission provides for the waiver of use charges for special nuclear material for a period ending 5 years after the date of PRDC's facility license. On the basis of its present construction and operating schedule, this date would be approximately August 31, 1960, so that the waiver period would terminate August 31, 1965. The estimated amount of use charges waived during construction and 1 year of low-to-full power test operation is $1,169,400, while the use charges waived for the operating period are $2,533,200. These total $3,702,600 and are unchanged from the estimate furnished to the Joint Committee by PRDC and the Commission last year. See hearings before the Subcommittee on Legislation of the Joint Committee on Atomic Energy on authorizing legislation for fiscal year 1958, 85th Congress, 1st session (1957), pp. 445–446, 653.

FINANCING ARRANGEMENTS

It will be seen by reference to schedule 2 that PRDC's total projected expenditures on construction and research and development total $39,020,000. (Reactor plant costs of $37,020,000, less $3 million of equipment and devices to be furnished by APDA, plus $5 million of research and development work to be paid for by PRDC.) If to this is added an allowance of $1,175,000 for working capital, PRDC's financial requirements total $40,195,000 for the construction and test period ending August 31, 1961. PRDC has successfully concluded definitive arrangements to meet these anticipated requirements.

Firm commitments were made in 1956 by PRDC's member companies and their affiliates for the contribution to PRDC of $23,540,000 in the period 1956 through 1960. During the past year URDC received additional firm contribution commitments from its utility member companies and their affiliates for additional contributions to be made in the year 1961 in the amount of $3,908,000. In addition, all necessary guaranty agreements have been executed and PRDC's loan agreement of October 30, 1956, with a group of New York banks headed by J. P. Morgan & Co., Inc., providing for the loan to PRDC of $15 million, is in full force and effect; as of February 1, 1958, a total of $8 million had actually been taken down

by PRDC in accordance with the terms of this loan agreement. Accordingly, PRDC's firm contribution and loan agreements provide it with resources of $42,448,000, with which to meet total anticipated requirements for the period ending August 31, 1961, of $40,195,000. In addition, APDA's agreement to furnish PRDC at least $7 million of research and development services and equipment to be incorporated in the reactor is, of course, still in effect.

During 1957, PRDC received a ruling from the Internal Revenue Service that contributions received from its member companies do not constitute income to PRDC under the Federal income tax laws. Accordingly, PRDC will have no taxable income during its construction and test period and will, therefore, be subjected to no income tax liability during this period. During its subsequent projected 10-year operating period, however, PRDC has made provision for Federal income tax payments. See testimony in hearings before the Subcommittee on Legislation of the Joint Committee on Atomic Energy on authorizing legislation for fiscal year 1958, 85th Congress, 1st session (1957), pages 447–450.

CONSTRUCTION PERMIT PROCEEDINGS

PRDC's original application for license under section 104 b. of the Atomic Energy Act of 1954 was filed with the Atomic Energy Commission on January 6, 1956. On August 4, 1956, the Commission issued to PRDC a construction permit on a provisional basis. The permit provided that its conversion to a license was subject to submission of a final hazards summary report which would adequately demonstrate the safety of the reactor as finally designed and built. Continuation of the construction permit was conditioned upon the submission by PRDC within 12 months of further proof of its financial resources and qualifications. This period was subsequently extended pending the decision of the Commission in the proceedings described below.

On August 31, 1956, within 30 days of the issuance of the provisional construction permit, several labor unions and a number of the individual officers of those unions filed a petition to intervene and to oppose the issuance and continuation of the construction permit, contending that the requisite showing of safety and of financial qualification had not been made. They requested that the construction permit which had been issued on August 4, 1956, be suspended.

In an order entered on October 8, 1956, the Commission found that no public hazard could be created by activities authorized by the provisional construction permit, and accordingly denied the intervenors' request to suspend it pending further proceedings. The Commission granted the intervenors' request for hearing, however, and set the matter down for a formal hearing on the issues of safety of operation and financial qualification before a hearing examiner, the Honorable Jay A. Kyle.

The hearing was formally opened for the taking of evidence on January 8, 1957, and with adjournments from time to time continued until August 7, 1957. In the course of the proceeding the testimony of some 17 witnesses was taken. The record, which comprises a total of about 6,300 pages of material, was certified to the Commission by the examiner on November 22, 1957, and the last briefs were submitted to the Commission on November 29. The matter is presently pending before the Commission.

PRDC believes that it has more than met the burden of proving all facts needed to sustain the continuation of its construction permit. No witness testified that he thought that presently available information indicates that fast reactors generally or the proposed PRDC reactor specifically is inherently unstable, unreliable, or unsafe. On the contrary, all 10 of the expert physicists and engineers who testified for the various parties to the proceeding with respect to fast reactor technology and engineering (including several members of the Advisory Committee on Reactor Safeguards) were of the opinion that, while further verification of safety must be had before operation at power, the research and test programs underway and proposed will probably provide such verification by the time the reactor is completed.

As noted above, an important part of this experimental verification has since been obtained from the initial experiments with the Mark III core on EBR–I, which Dr. Hilberry has described as indicating that the positive power coefficient has been eliminated.

A more detailed summary of PRDC's position in the pending construction-permit proceedings is set forth in the supplemental statement of Robert W. Hartwell, included in hearings before the Subcommittee on Legislation of the Joint Committee on Atomic Energy on Authorizing Legislation, 85th Congress, 1st session, 1957, pages 633–639, and in the briefs filed by PRDC with the Commission.

Other Matters

INSURANCE

PRDC in common with all others in the field of atomic energy was pleased at the passage of the Anderson-Price amendment by the last session of Congress, to provide indemnity insurance in excess of that which is commercially available. PRDC has filed an application with the private insurance industry for insurance on its reactor, and the insurance engineers are now working with PRDC personnel. After these arrangements have been completed, and prior to operation, PRDC will seek an indemnity agreement with the Commission as contemplated by the Commission's tentative regulations issued under the Anderson-Price amendment.

RELATIONSHIP WITH THE UNITED KINGDOM AND BELGIUM

During the latter part of the past year PRDC and the Societe Belge Pour L'Industrie Nucleaire entered into a contract, providing for mutual exchanges of information which is now being carried out. Representatives of PRDC have also recently visited the United Kingdom Atomic Energy Authority facilities in Great Britain, including Calder Hall and the Dounreay installation where the British are constructing a fast breeder reactor which is scheduled to go critical later this year. British data with respect to the Dounreay reactor are currently being made available to PRDC through the Commission.

PERSONNEL TRAINING

During the year PRDC also initiated the training of some of the future operating and maintenance personnel of the plant. A plant superintendent and two maintenance engineers are now in training at operating reactors.

CONCLUSION

There can be no question but that the fast breeder reactor is one of the most promising types for the eventual development of electric power from nuclear fission on a commercially feasible basis. Dr. Hans Bethe, one of the greatest authorities in this field, said in his testimony in the proceedings before the Atomic Energy Commission (NT 11):

"The expeditious construction of a full-scale breeder is in my opinion an essential step in any large-scale program of developing economically feasible nuclear power."

The fact that the British have given such high priority to the fast breeder reactor now being completed at Dounreay, Scotland, that the Belgians are actively at work to develop such a project, and that the Russians are reported also to have a reactor of this type underway, are further indications of the importance to the United States of progressing as rapidly as possible in this field. The PRDC reactor and the Commission's experimental breeder reactor No. II (EBR–II) together constitute the principal American projects in this category. These two projects are complementary, and each is essential if we are not to fall seriously behind other nations in this field. As Dr. Norman Hilberry, director of Argonne National Laboratory, described it in his testimony in the proceedings before the Commission (NT 39–40);

"The PRDC reactor is designed to demonstrate the production of as nearly economically competitive power as is possible, and to do so with as few deviations as possible from EBR–I proven principles and technologies. EBR–II, on the other hand, is designed as an engineering test facility; it is a tool for the scientist and engineer, not primarily a power production installation."

In other words the PRDC reactor is designed to demonstrate the feasibility of utilizing a fast breeder reactor in the day-to-day production of electric power on a substantial scale. EBR–II, on the other hand, is an advanced reactor experiment which will test further steps in sodium-cooled fast reactor technology, and will go forward with the full plutonium fuel cycle, including pyrometallurgical reprocessing.

PRDC is mindful of its responsibilities in this important area. Its management includes responsible senior officers of important public-utility and other business enterprises, including competent engineers and physicists. Public safety has been and will continue to be of prime concern to this management as well as to its consultants. The PRDC management fully recognizes that before it can operate its reactor it must not only be satisfied itself but must affirmatively demonstrate to the satisfaction of the Commission that no credible accident can result in radioactive hazard to the public. It also recognizes that the primary objective of the project, to make progress toward demonstrating the economic feasibility of using nuclear power to generate electricity, can only be accomplished if public safety is and remains of prime concern. Adequate assurance of safety will certainly never be sacrificed to economy or expediency.

As noted above, progress in all phases of the project has been significant during the past year. Construction at the site and fabrication of components has progressed very well, as have the research and development programs.

PRDC and its member companies appreciate the opportunity which has been given to them of utilizing this means of making a genuine contribution to the peaceful application of atomic energy and to the maintenance of world leadership of the United States in this field.

Respectfully submitted.

POWER REACTOR DEVELOPMENT CO.,
By WALKER L. CISLER, *President.*

(The schedules referred to follow:)

SCHEDULE 1.—*Enrico Fermi plant expenditures to date by the Detroit Edison Co., Power Reactor Development Co., Atomic Power Development Associates, Inc.*

	Prior to 1957	During 1957 [1]	Total
Nonnuclear portion of plant: Plant expenditures by the Detroit Edison Co.	$1,001,212	$709,500	$1,710,712
Nuclear portion of plant:			
Plant expenditures by PRDC (construction work in progress, architect-engineer, net loan interest and commitment fee)	387,015	1,955,500	2,342,515
Plant and major components test facility expenses by APDA	108,940	1,200,000	1,308,940
PRDC administrative and overhead expenses	222,562	593,000	815,562
Total plant, PRDC overhead and test facility expenses	718,517	3,748,500	4,467,017
Research and development:			
Research and development expenses by PRDC	12,936	216,000	228,936
Research and development expenses by APDA (attributable to the PRDC project)	7,064,832	[2] 2,300,000	9,364,832
Total research and development expenses by PRDC and APDA	7,077,768	2,516,000	9,593,768
Total	8,797,497	6,974,000	15,771,497

[1] 1957 figures approximate; audited figures not yet available.
[2] In addition, APDA had approximately $470,000 of administrative expenses in 1957 attributable to work done for PRDC.

NOTE.—Schedule 1 of statement submitted by Power Reactor Development Co. at an open hearing before the Joint Committee on Atomic Energy, Mar. 4, 1958.

SCHEDULE 2.—*Estimated overall cost summary, Enrico Fermi plant*

	PRDC	APDA	Detroit Edison	AEC	Total
Nonnuclear portion of plant:					
Site and development			$925,000		$925,000
Structures and equipment			12,976,000		12,976,000
Interest during construction			160,000		160,000
Total			[1] 14,061,000		[1] 14,061,000
Nuclear portion of plant:					
Plant costs, including fabrication of initial core and blanket elements (PRDC and APDA)	$31,850,000	[2] $3,000,000			34,850,000
PRDC administrative and overhead expenses during construction and testing (through Aug. 31, 1961)	2,170,000				2,170,000
Total	[3] 34,020,000	[2] 3,000,000			[3] 37,020,000
Research and development:					
By APDA–PRDC, 1952–56	12,936	7,064,832			7,077,768
By APDA–PRDC, 1957–60	4,987,064	[2] 4,000,000			8,987,064
By AEC in Commission facilities				$4,450,000	4,450,000
Total	5,000,000	[2] 11,064,832		4,450,000	20,514,832
Amount of use charges waived:					
Construction and test period, 1958–Aug. 31, 1961				1,169,400	1,169,400
Operating period, Sept. 1, 1961–Aug. 31, 1965				2,533,200	2,533,200
Total				3,702,600	[4] 3,702,600
Grand total	39,020,000	[2] 14,064,832	14,061,000	8,153,000	75,298,432

[1] This estimate is being revised. See separate statement submitted by the Detroit Edison Co.
[2] These figures represent the minimum contribution committed to be made by APDA; in fact total APDA contributions are expected to be in excess of these figures.
[3] These figures do not include an allowance for working capital for PRDC of $1,175,000.
[4] By the terms of the AEC–PRDC contract, effective Jan. 1, 1957, use charges for special nuclear material are waived for the period ending 5 years after the date of PRDC's facility license. On the basis of its present schedule, this date would be Aug. 31, 1960, so that the waiver period would terminate Aug. 31, 1965.

NOTE.—Schedule 2 of statement submitted by Power Reactor Development Co. at an open hearing before the Joint Committee on Atomic Energy, Mar. 4, 1958.

Mr. TOLL. Sixth: Letter to Chairman Durham, dated February 27, 1958, enclosing statement for the record, from Mr. N. A. Cocke, president of the Carolinas Virginia Nuclear Power Associates, Inc.

CAROLINAS VIRGINIA NUCLEAR POWER ASSOCIATES, INC.,
Charlotte, N. C., February 27, 1958.

HON. CARL T. DURHAM,
Chairman, Joint Committee on Atomic Energy,
Congress of the United States, Washington, D. C.

DEAR CONGRESSMAN DURHAM: Herewith you will find a copy of a statement on behalf of Carolinas Virginia Nuclear Power Associates, Inc., which I am today mailing Mr. Ramey for inclusion in the record of the hearings of your committee. I wish to particularly direct your attention to the comment on page 4 with respect to an amendment of the Holding Company Act which would make possible a joint effort such as that involved in the Carolinas Virginia Nuclear project without exposing the companies participating in the effort to the burdens of the Holding Company Act. We sincerely hope that legislation may be adopted which will correct the handicaps imposed by existing law.

I am sure that you will be glad to know that we seem to be in substantial agreement with the staff of the Commission on our proposal. As you will see from my statement, we are having to spend a great deal more money than we had originally anticipated.

With kindest personal regards, I am

Sincerely yours,

N. A. COCKE, *President.*

STATEMENT BY N. A. COCKE, PRESIDENT, CAROLINAS VIRGINIA NUCLEAR POWER ASSOCIATES, INC.

In February of last year Carolinas Virginia Nuclear Power Associates, Inc., filed with your committee a statement reviewing its plans and preparations for construction of a nuclear powerplant. (As was pointed out in our previous statement, CVNPA is a nonprofit corporation organized by Carolina Power & Light Co., of Raleigh, N. C.; Duke Power Co., of Charlotte, N. C.; South Carolina Electric & Gas Co., of Columbia, S. C.; and Virginia Electric & Power Co., of Richmond, Va. These companies presently constitute the membership of Carolinas Virginia Nuclear Power Associates.) At that time we had executed a contract with Stone & Webster Engineering Corp. for engineering consultation, design, and supervision, and were negotiating with General Nuclear Engineering Corp. for their services as nuclear consultants. Subsequently, a contract was made with General Nuclear Engineering Corp. and also a contract was made with Westinghouse Electric Co. for the design and construction of the reactor for our plant.

Research and investigation were undertaken and completed as rapidly as possible for the preparation of a proposal to be made to the Atomic Energy Commission. In August of 1957 we filed this proposal with the Commission. Our proposal contemplates the construction of a prototype plant having a nominal gross electrical capacity of 19,000 kilowatts. The reactor for the proposed plant is to be a vertical pressure tube prototype, moderated and cooled with heavy water and fueled with uranium with an equivalent enrichment of approximately 2 percent. It is contemplated that the plant will verify the development and research program and furnish data for the evaluation of a future plant of 200 megawatts capacity or larger. We anticipate that the proposed prototype design, if proved successful, can be applied to a larger-scale reactor, fueled with normal uranium. The proposed plant would be constructed in response to the third invitation of the Atomic Energy Commission under its power demonstration reactor program and our proposal contemplated completion of the plant by June 30, 1962.

The site of the proposed plant is adjacent to the Parr Shoals steam plant of the South Carolina Electric & Gas Co., approximately 25 miles northwest of Columbia, S. C., on the Broad River. By locating our plant at this point we plan to use the existing turbine and generating facilities and thereby reduce the cost of the construction of the proposed prototype.

Negotiations have been in progress with the Atomic Energy Commission since the proposal was filed in August and it is believed that we are now in substantial agreement with the staff of the Commission with respect to our proposal. At the insistence of the staff of the Commission we have increased our estimated commitment in connection with the proposed plant by over $5 million. Presently, the cost of the project to CVNPA, Inc., including plant construction, financing, and 5 years operating deficit, is estimated to be in excess of $26 million. By agreement between the four companies comprising the membership of CVNPA, Inc., this cost will be shared in the following proportions:

	Percent
Duke Power	34
Virginia Electric Power Co	33½
Carolina Power & Light Co	20
South Carolina Electric & Gas Co	12½

The $5 million additional cost assumed by us in excess of the cost indicated in our proposal is made up of 3 items. Our proposal contemplated that the Atomic Energy Commission would bear the cost of fabricating the first core but the staff has insisted that we assume this cost. It was our thought that the preparation of the first core should properly be treated as a research and development expenditure as the production of our plant will not be for commercial purposes. While it is true that the steam produced by our reactor will be used for production of electricity which will be sold to the public, the fact is that the cost of producing this steam is greatly in excess of the cost of producing such steam by other means. This steam is being used for the production of electricity as a means of measuring the capabilities of the reactor and in connection with the experimental development of the reactor. The entire project is for experimental purposes and could not be undertaken as a commercial venture.

The second item of the increased cost which we have assumed is that the staff has insisted that we agree to operate the plant for 5 years instead of for 3 years as we proposed. We felt that the plant could be adequately tested in 3 years.

The third item constituting the increased cost which we have assumed is the rental of heavy water in the amount of approximately $420,000. The Atomic Energy Commission informed us that it does not have the authority to waive rental of heavy water at the present time. We understand that consideration may be given to granting the Atomic Energy Commission authority to waive use charges for heavy water. We urge that this authority be granted.

In my statement filed last year, I mentioned two items then before Congress. The first was the matter of castastrophe-insurance protection with respect to which legislation has been enacted. The second item which I mentioned was the application of the Holding Company Act to companies participating in joint efforts such as that of Carolinas Virginia Nuclear Power Associates, Inc. I pointed out that none of the companies now members of CVNPA are subject to the Holding Company Act and that under the rules of the Securities and Exchange Commission, they will not become subject to the Holding Company Act so long as CVNPA merely produces steam which is sold for the generation of electricity. This, however, is not a satisfactory situation and can be objectionable in our operations. We respectfully suggest that Congress give careful consideration to legislation of the type contemplated by Senate bill 2552 which is presently pending before the Committee on Interstate and Foreign Commerce.

On behalf of myself and also on behalf of the companies which are members of Carolinas Virginia Nuclear Power Associates, Inc., I wish to again express our sincere appreciation for the opportunity to review the progress of our undertaking. We feel sure that your committee would like for our project to get underway and we assure you that we are anxious to proceed. We hope that at an early date we will have final approval of our proposal and will be able to complete a contract with the Atomic Energy Commission for our plant.

Mr. TOLL. Seventh: Letter dated February 25, 1958, from E. W. Morehouse, vice president of the General Public Utilties Corp.:

Hon. CARL T. DURHAM,
Chairman, Joint Committee on Atomic Energy,
Congress of the United States, Washington, D. C.

DEAR CHAIRMAN DURHAM: This letter is submitted in response to your communication of January 20, 1958, inviting the General Public Utilities Corp. to submit a statement in connection with the current section 202 hearings. This statement will bring up to date our previous letters, including the latest dated September 12, 1957, reporting on our atomic-energy activities.

As previously reported, General Public Utilities Corp. owns, in addition to domestic electric utility subsidiaries in Pennsylvania and New Jersey, the Manila Electric Co., in the Philippines. Because this foreign subsidiary uses fossil fuel costing about 1½ times the present highest level of fuel costs in our domestic system, and therefore could be expected to be the earliest place among our properties where a nuclear powerplant might be economically justifiable, our principal efforts up until the last few months were directed toward determining the feasibility of installing a nuclear powerplant on the Manila system. Following preliminary studies and discusssions with equipment manufacturers, we invited proposals for the installation of a 60 electric megawatt nuclear powerplant in Manila. During the year just past, General Public Utilities Corp. completed an evaluation to the extent considered necessary of the two proposals which we received, both for water-type reactors. As explained in more detail in our letter of September 12, 1957, and accompanying report, we concluded that acceptance of either proposal received could not possibly be economically feasible. Not only was capital investment for a nuclear powerplant at least three times that for a conventional fuel plant in Manila, but no immediate savings in fuel costs were expected to be realized and possible fuel-cost savings in the next decade from the use of nuclear fuel were insufficient in amount and too conjectural to make the project at all feasible.

As a result of our evaluation study of the Manila nuclear powerplant proposal, we have reexamined and refocused our thinking with respect to our participation in the development of nuclear power technology.

While we have concluded that the Manila project is not feasible at the present time, we share the conviction of others that there are promising long-run prospects for technical improvements and cost reductions in water-type reactors.

These improvements and cost reductions seem to us most likely to come about in the next few years through simplification in design and equipment, through increases in heat output, and through fuel use and handling economies. We be-

lieve these will in turn be made possible in large measure through actual operating experience, and the water-type reactor is the earliest type likely to afford such experience.

Therefore, we have during the last few months been exploring in detail with equipment manufacturers the feasibility of adding a small water-type nuclear reactor at our Saxton, Pa., power station, and of "hooking on" the reactor to the existing steam turbo-generators. The hook-on concept has the immediate advantage of reducing total investment by eliminating the need of purchasing new electrical generating equipment. It also has the advantage that continuity of station operation can be maintained through the use of existing steam-generating facilities whenever it becomes necessary or desirable to shut down the nuclear reactor. We will not have to place the same emphasis on continuity of operations of the reactor that would be necessary in a large-scale nuclear plant. Also, we believe that it should be possible to keep our reactor and auxiliary equipment to a minimum and within a practical cost range. By limiting the size and scale of investment so that the hook-on reactors can be considered as an experimental and expendable plant devoted to the development of the art, we can afford to push it to the limits of performance consistent with safe operations, and in this way should be able in a relatively short time to obtain data which will be important in the design of new reactors as well as in the operation of large plants already under construction.

This approach to the development of atomic power has a number of attractive features. Some of these are—

1. It is dedicated primarily to the advancement of the art and not at the generation of large quantities of energy.

2. It provides a means whereby a utility can make an early contribution to reactor development and at the same time gain valuable practical experience for itself as well as others.

3. It concentrates on the stepwise development of the water reactor through actual experience, and is aimed at the determination of the capability of this type of reactor, primarily by exploring potential improvements in reducing fuel costs.

4. It provides a versatile and flexible facility available for determining, under actual operating conditions, performance limitations.

While General Public Utilities Corp. and its subsidiaries will gain valuable experience in the operation, maintenance, and the general problems of designing and building a nuclear reactor, the project would also contribute to reactor development. General Public Utilities Corp. necessarily looks to the reactor designer and manufacturer for technical ideas and judgments about the details of greater design and operation and about the contribution which the project can be expected to make to reactor technology. Therefore, General Public Utilities Corp. considers it essential that a competent reactor designer and manufacturer be found who regards the project as an important and integral part of his own plans for the development of the art, and who will agree to participate technically and financially in the project on a joint basis.

General Public Utilities Corp.'s detailed exploration of this project with several manufacturers is continuing but it will be some months before these investigations are concluded and we can determine whether or not the project will justify the substantial financial commitment which would be required of General Public Utilities Corp. If the General Public Utilities Corp.'s management succeeds in its present efforts to develop a worthwhile project, we shall promptly submit it to our board of directors for consideration. We have already advised our board that while we are not yet in a position to submit firm estimates to them for either capital or operating expenses, it is hoped that when negotiations are completed the financial dimensions of the capital investment in General Public Utilities Corp.'s share of the program will be below $8 million spread over several years. We have also advised our board that we regard the $8 million ceiling figure as bearing a reasonable relationship to our capital structure.

As in the past, we will keep the joint committee advised of developments in our plans.

Sincerely yours,

E. W. MOREHOUSE, *Vice President.*

Mr. TOLL. Eighth: Letter dated February 4, 1958, from John P. Gallagher, director of utilities, city of Piqua, Ohio.

Subject: Your letter of January 20, 1958.

Congressman CARL T. DURHAM,
Chairman, Joint Committee on Atomic Energy,
House Office Building, Washington, D. C.

DEAR CONGRESSMAN: Thank you for your letter of the captioned date.

The writer has no specific comments to make on the general topics suggested for discussion at this time.

In connection with the progress of contract negotiations between AEC and the city of Piqua relative to the installation of an organic moderated reactor at Piqua, these negotiations appear to be progressing on a reasonable basis and no particularly difficult problems appear to exist with respect to this specific contract.

Present delays in the completion of the contract appear to be chargeable to certain problems being encountered between AEC and Atomics International with respect to the contract for design and construction of the reactor. It is the writer's understanding that the basic problems involved concern patent clause requirements and proprietary rights to detailed design of the reactor.

It is also my understanding that this subject is under discussion currently between representatives of AEC and Atomics International.

It is the writer's opinion that very serious problems may exist in attempting to arrive at a solution satisfactory to both AEC and Atomics International without disturbing the present price structure of the design and construction phase of the proposal.

It appears to the writer that the problem which is involved in this particular contract is one which could seriously affect various other contracts in the civilian atomic power development program, and hence, is worthy of your consideration.

Very truly yours,

JOHN P. GALLAGHER,
Director of Utilities.

Mr. TOLL. Ninth: Letter date February 27, 1958, from F. H. King, manager of the city of Holyoke, Mass., Gas and Electric Department, forwarding a statement dated February 18, 1958:

Mr. JAMES T. RAMEY,
Executive Director, Joint Committee on Atomic Energy,
Capitol Building, Washington, D. C.

DEAR MR. RAMEY: I have received your letter of February 20, 1958, concerning a statement for the record for the hearings on the Joint Committee on Atomic Energy.

Accordingly, I am submitting attached hereto three copies of a statement prepared by the signatory officials of the Department.

Thanking you for your cooperation in this matter,

Yours very truly,

GAS AND ELECTRIC DEPARTMENT,
F. H. KING, *Manager.*

FEBRUARY 18, 1958.

To the Joint Committee on Atomic Energy, Congress of the United States.

GENTLEMEN: The following statement is in response to your invitation dated January 20, 1958, for comments in connection with the section 202 hearings.

The city of Holyoke Gas and Electric Department is a municipal corporation owning and operating its own gas and electric plant subject to the provisions of the general laws of the Commonwealth of Massachusetts. Holyoke was one of the seven proposers that submitted proposals to the Atomic Energy Commission under the second round of the power reactor demonstration program. Holyoke's proposal (contemplating the construction and operation of a closed-cycle gas-cooled reactor) was rejected by the Commission as a basis for negotiation on the grounds that the proposed concept was too technically advanced. However, despite the rejection of its proposal, the interest and concern of Holyoke in the

atomic energy industry, and particularly in that phase of the industry pertaining to the development of small nuclear power plants, has continued.

In this statement, therefore, the undersigned officials of the Holyoke plant desire to express to the committee their views with regard to the particular problem of small power reactor development.

I. PRESENT STATE OF DEVELOPMENT OF SMALL REACTOR POWERPLANTS

More than 2 years have passed since the Atomic Energy Commission first issued its invitation for proposals in the second round of the power demonstration reatcor program. The second round of the program was devoted to the development of small nuclear powerplants (5,000 to 40,000 kilowatts).

As of the present date, it is understood that no construction has been undertaken nor has any contract been executed contemplating construction of a reactor pursuant to the program and that of the seven original proposals, only two remain in the process of negotiation. However, despite what appears to be a complete lack of progress, the Atomic Energy Commission has taken the position that the second round of the program is closed, and that no further proposals can be accepted thereunder.

II. DESIRABILITY OF DEVELOPMENT OF SMALL NUCLEAR POWERPLANTS

It is the contention of the officials of the Holyoke plant that the public interest requires the prompt development of small nuclear powerplants. This conviction is based on several considerations.

(*a*) At the present time there are in existence throughout the country many municipalities and rural coperatives owning and operating their own electric plants. The interests of these plants demand that they have the opportunity to share in the benefits to be derived from the atomic age. Such plants, however, are typically small in size, and therefore require relatively small generating facilities for their purposes. Plants of this type, by their very nature, are not usually adapted to take advantage of the development of large nuclear powerplants, but must, of necessity, rely upon the development of plants of small capacity.

It is therefore submitted that the interests of this substantial segment of the existing electrical industry, require the development of small nuclear powerplants.

(*b*) There is a great advantage to be gained from the development and operation of relatively small nuclear powerplants in the event of a national emergency. It seems obvious that under modern conditions, the national defense would require that power sources be widely dispersed and not concentrated in a few areas where they would be susceptible to immediate enemy attack. Furthermore, it seems apparent that the ultimate replacement of present small conventional generating plants with small nuclear generating plants would provide relief to the national transportation system which would be most desirable in time of war. It therefore seems clear, that the development of small nuclear power reactors is required in the interests of national defense.

(*c*) It should also be suggested that the development of small nuclear powerplants would assist materially in the development of isolated areas throughout the country where transportation is a major item of expense. A small nuclear powerplant would provide a means of supplying such areas with an economically feasible power supply.

It is therefore submitted that the development of a small nuclear power reactor would prove to be of great assistance in the development of our natural resources.

(*d*) It also seems evident that a small nuclear powerplant, once satisfactorily developed, would find a ready and valuable foreign market, and assist materially in aiding presently lagging United States foreign prestige. A small and compact plant, capable of exportation, could provide a source of electric power which would be economically attractive to those foreign countries that do not possess their own supply of conventional fuels.

For these reasons, it is therefore submitted that the development of such a small nuclear powerplant is also in the interests of the national economy.

III. THE THIRD ROUND OF THE POWER REACTOR DEMONSTRATION PROGRAM IS NOT SUITABLE FOR THE DEVELOPMENT OF SMALL POWER REACTORS BY MUNICIPALITIES AND RURAL COOPERATIVES

At the present time the only program under which the Atomic Energy Commission will accept proposals for the development of nuclear powerplants is the so-called third round of the power reactor-demonstration program.

Whatever may be the merits of this particular phase of the program, it seems clear that this "round" is not suitable for the development of small nuclear power reactors by municipalities or rural cooperatives.

The principal obstacle to the development of small nuclear powerplants under the third round is the provision contained in the Commission's invitation that no part of any payments made by AEC under contracts executed pursuant to the invitation, may be used to defray any part of the capital costs of the proposed reactor. (See Fact Sheet for Power Demonstration Reactor Proposals, issued under third invitation, par. 7C.)

It seems obvious that proposals for the construction of small power reactors, can only be expected to come from small existing electric utilities. The economics of the electrical industry is such that large electric utilities cannot be expected to be interested in the construction of small plants. Large utilities would probably be interested in small reactors only insofar as they would serve as prototypes for larger plants.

It also seems obvious that the costs of construction of the first plant of any particular design will far exceed the costs of construction of subsequent copies of that plant. Therefore, a utility that would undertake to build the first of any such plants would necessarily place itself in an unfavorable competitive position, unless it were assured of a means to recoup the excess costs of construction in consideration of its undertaking.

The provision of the AEC invitation prohibiting any recovery of such excess costs is therefore an effective bar to active participation in the program by a small utility. It follows that the provision is also an effective bar to the development of small power reactors.

It appears that this provision is probably based upon an interpretation of the Atomic Energy Act of 1954. Paragraph 9F of the Fact Sheet for Power Demonstration Reactor Proposals, issued with the third-round invitation, provides as follows:

"Attention is called to the fact that the Commission is prohibited by section 169 of the Atomic Energy Act of 1954 from providing funds to be employed in the construction or operation of a licensed facility except as such funds are provided pursuant to an arrangement for research and development assistance." It should be noted, however, that the provision constitutes a distinct departure from the policy announced by the AEC in the previous two rounds of the program, under which the Commission considered financing all or part of the nuclear portion of the proposed plants, maintaining title to the parts so financed.

It is submitted that the construction of a nuclear power reactor is in itself an exercise in research and development (where a similar plant has not been previously constructed), and that the provisions of section 169 of the Atomic Energy Act were not intended to prohibit the Commission from helping to defray the costs of such construction.

It is further submitted that the provision of the third-round invitation prohibiting the use of AEC payments to defray costs of construction is both an unnecessary and unrealistic obstacle to small power reactor development.

IV. CONCLUSIONS AND RECOMMENDATIONS

In view of the foregoing, it is our conclusion that although, as previously stated, the public interest urgently requires the prompt development of small nuclear power reactors, presently existing programs have proved themselves to be completely inadequate for the provision of such development. It is therefore recommended that either—

(*a*) A new program be instituted which will realistically allow and therefore attract new proposals from small utilities for the development and construction of small powers reactors; or

(*b*) That the Federal Government provide for such development and construction at complete Government expense.

It is suggested that a reopening of the second round of the power reactor demonstration program might, under present conditions, constitute an effective measure toward attracting new proposals from utilities.

Respectfully submitted.

CITY OF HOLYOKE, MASS., GAS AND ELECTRIC DEPARTMENT,
F. H. KING, *Manager.*
D. M. BALLOU, *Nuclear Project Officer.*
J. W. MORIARTY, *Counsel.*

Mr. TOLL. Tenth: Letter dated February 3, 1958, from Mr. Herbert D. Vogel, Chairman of the Tennessee Valley Authority.

DEAR MR. DURHAM: Thank you for your letter of January 20, 1958, inviting TVA's comments on the development, growth, and state of the atomic-energy industry.

As you may know, TVA for the past several years has been actively investigating the possibilities of developing power economically from atomic fuel. Our studies have been carried out in the main through participation of our staff in the work being conducted in the various laboratories and installations of the Atomic Energy Commission. We have been discussing with AEC arrangements which we believe would make our participation in the overall program more effective and provide substantial advantages to both the Commission and TVA.

While TVA is greatly interested in developments in this field, we do not believe that we have information to present on the subjects listed in the attachment to your letter that is not normally available to your committee. If there is any specific information that you may desire from us, we shall of course be glad to supply it. It would not appear necessary, however, for TVA to participate in the hearings.

HERBERT D. VOGEL, *Chairman*
(For the Board of Directors).

Mr. TOLL. Eleventh: Letter dated February 10, 1958, from Mr. Carroll L. Wilson, of the Metals & Controls Corp., Attleboro, Mass.

Mr. JAMES T. RAMEY,
Executive Director, Joint Committee on Atomic Energy,
Washington, D. C.

DEAR JIM: I am writing to you in reply to the invitation I received from Congressman Durham to appear at the section 202 hearings. We have discussed among ourselves here the items that might be relevant for us to present at that time and have concluded that there are none that we believe we can present which would add materially at this time to the picture which the Joint Committee will have as a result of these hearings.

It does seem to me important that the Commission define more clearly the objectives in terms of the atomic power program and the schedule which for reasons of Government policy, perhaps predominantly foreign policy, that these objectives be reached at a certain point in time. I recognize that it is easier to talk about objectives than to define them. However, it does seem to me that if for reasons of national policy it is desirable that civilian atomic power be brought to a point where purchases of plants can be made in which the power will be available at X mills per kilowatt-hour and that this time should be 5 or 10 or Y years hence, such definition of objectives would permit an appraisal of whether the program now, or as revised, would be likely to yield this kind of result.

If, on a general basis, one wants economic atomic power at some time in the future, the parameters for defining a program become very vague. On the other hand, if one were to say, for example, that we want 12-mill power in 5 years, and 8-mill power in 10 years, there are some dimensions provided which indicate the kind of program, and framework, and schedule, and scale of expenditure and effort which are needed to have a good chance of getting there.

This is the only thought I would wish to leave with you and I know you will find ways of bringing this to the attention of the committee.

With best regards,

Sincerely,

CARROLL L. WILSON.

Mr. TOLL. Twelfth: Letter dated February 6, 1958, from Alfred Iddles, president of the Babcock & Wilcox Co.:

CONGRESS OF THE UNITED STATES,
Joint Committee on Atomic Energy.
Capitol Building, Washington, D. C.
(Attention: Mr. David R. Toll.)

GENTLEMEN: Because I will be out of the United States during the period set aside for the section 202 hearings, I am replying to your invitation to testify, or submit a statement for the record, with the following comments.

I believe that the most useful method for increasing our knowledge in the field of atomic power and for assisting an accelerated program would be to authorize and urge the AEC to develop programs for the design and construction of small plants involving new concepts which will require considerable development work before the construction and operation of a so-called prototype plant.

A specific example of this procedure is well set forth in the proposal for such a development program made by the American Gas & Electric Co., its associated utility companies in Ohio, and two utility companies in Florida, where the plant would be constructed.

I believe there are other development projects which could be undertaken and would produce better plants than we know how to design at the present time.

An accelerated program will require greater expenditure than would be justifiable by strictly commercial considerations and Government assistance in this development work would, I believe, be very helpful and entirely appropriate.

A second means for assisting an accelerated program would be for the Government, in its own laboratories, and by subcontracts with other research organizations, to perform research and test work in the area of metallurgy and fuel elemen design and construction.

Many of these tests require considerable time and the results would be widely useful to a great many industries and to the Government itself. I believe the facilities and manpower are available, and the end results would be very helpful.

I am sure that industry will undertake as much of this research and development work as it can afford to do under present commercial conditions. I am also sure that industry will cooperate with your committee and with AEC to the fullest extent because our basic desires are the same.

Very truly yours,

ALFRED IDDLES.

Mr. TOLL. Thirteenth: A letter dated February 10, 1958, from Mr. Bennett Boskey, of Volpe, Boskey & Skallerup, 1701 K Street NW., Washington, D. C.

Hon. CARL T. DURHAM,
Chairman, Joint Committee on Atomic Energy,
Congress of the United States, Washington, D. C.

DEAR MR. DURHAM: I appreciate your letter of January 20, 1958, inviting me either to testify or to submit a written statement for inclusion in the record of the annual section 202 hearings which will soon be held by the Joint Committee on Atomic Energy, relating to the development, growth, and state of the atomic energy industry. This is written in response to your invitation.

This year's section 202 hearings come at a time when the atomic energy program of the United States is undergoing a fundamental reappraisal in the light of recent events at home and abroad. At such a time the responsibilities which rest upon the Joint Committee and the Atomic Energy Commission are indeed grave. It is to be hoped that the forthcoming section 202 hearings will develop factual data which can be useful in advancing the entire atomic-energy program.

In connection with these hearings, the Joint Committee certainly will be receiving comments and views on many important aspects of the atomic-energy program, covering both the domestic and the foreign implications. As you know, the subject of patents and inventions in the field of atomic energy has been one of the matters in which I have had an especial interest over the past years. In the hope of being of some help to the Joint Committee in your consideration of atomic energy from its broadest aspects, I offer a few comments on the patent and invention situation as I see it at the present time.

But at the outset, I should like to emphasize that patents are only one of a great many matters to be considered in connection with the development, growth, and state of the atomic energy industry. It is good to recognize the full importance of patents and their role as a stimulus to technological progress. Yet it is even more essential to keep the patent questions in perspective and to avoid giving them undue weight in relation to everything else.

It seems to me that there are a number of problems of really urgent importance which need to be considered by the Joint Committee at the present time. These include the state of the nuclear-power program; the problems of exchange of atomic energy information with foreign countries; the relationship between the atomic-energy program and the developmental effort for outer space; and other matters as well. In vew of this, I would suggest to the Joint Committee that an effort should not be made at this session of the Congress to amend the patent provisions of the 1954 Atomic Energy Act.

This is not for the reason that the patent provisions of the act have shown themselves to be perfect; far from it. For example, section 152 was recognized as a source of unanticipated and unwanted troubles almost as soon as the act was passed. Another provision which could well be overhauled is section 155, relating to the effect of secret "prior art" as a bar to patenting—although the difficulties arising out of the present text of section 155 probably have not yet begun to make themselves felt in any marked degree.

But whatever the defects of the patent provisions—some of which are unquestionably rather controversial—they can wait their turn until more important matters have been disposed of. It would make great inroads upon the time and the energies of the Joint Committee for you to undertake the kind of comprehensive review of the patent situation which, probably, the Joint Committee would wish to undertake before proposing important changes in the patent provisions of the act. In view of all the other legislative matters which ought to have a much higher priority from the Joint Committee at this session of Congress, it seems doubtful that the public interest would be served if the Joint Committee, at this critical time, were to risk becoming diverted by any preoccupation with the act's patent provisions.

This does not mean that the whole subject of patents in the field of atomic energy should be put away in mothballs for another year. Within the framework of the existing legislation there are many aspects of this subject which deserve attention. These, I am sure, are of continuing interest to the Joint Committee as they are to others.

The Atomic Energy Commission, it will be recalled, announced about 3 months ago that the Commission is currently reviewing its entire patent program. In that connection the Commission invited written comments or suggestions and indicated the possibility that the Commission would hold a public meeting on the subject at a later date. Thus far the Commission has not published the comments which have been received by it in response to its invitation.

The Commission's decision to embark upon an overall review of its patent program has aroused considerable interest. Especially in a field which is changing so rapidly, patent policies cannot be allowed to either remain wholly static or to outlive their usefulness. The basic purpose of having patent policies is to accomplish results which will be in the public interest from both the long-range and the short-range standpoint. As experience accumulates and as circumstances change, often the patent policies must change with them—or run the risk of becoming an obstacle rather than a spur to progress.

One point of general importance in connection with AEC patent policies is the need for assuring a high degree of public participation when the policies are being formulated. The Commission's present effort to solicit comments on its patent policies, and its indication of an intention to hold a public meeting on the subject, are certainly steps in the right direction.

In response to the Commission's request for such comments, I have sent them a letter, dated December 16, 1957, which gives my views on certain aspects of current AEC patent policies which I feel it would be useful for the Commission to review. For your information, a copy of that letter is enclosed. You will see that it refers specifically to AEC patent policies in the following areas:

(1) The award system established by the Atomic Energy Act;
(2) AEC contract policies;
(3) Foreign patenting problems;
(4) Section 152 waivers by AEC; and
(5) Access permit conditions imposed by AEC with respect to patent and invention rights.

These are all matters which can be reviewed within the framework of the existing legislation.

As indicated at the outset, legislative change in the patent provisions of the act does not seem to me a matter of urgent necessity. I would far prefer to see the Joint Committee devote its legislative efforts at this session to other matters where the urgency is more evident.

During the coming year, much progress can be achieved in the field of atomic-energy patents and inventions if a reasonable amount of attention is given to those items where correction or improvement can be made within the framework of existing law. If this can be accomplished, then the question of possible legislative changes in the patent provisions could always be considered anew when the Joint Committee holds its section 202 hearings a year from now in 1959.

In response to your invitation, I shall be glad to have this statement of my views—including the enclosed copy of my letter to the Atomic Energy Commission—made a part of the record of your current section 202 hearings for 1958.

Sincerely yours,

BENNETT BOSKEY.

Mr. TOLL. Fourteenth: A letter to Chairman Durham, dated February 24, 1958, from Newton I. Steers, Jr., president of the Atomic Development Mutual Fund, Inc., 1033—30th Street NW., Washington 7, D. C., enclosing a statement.

Hon. CARL T. DURHAM,
Chairman, Joint Committee on Atomic Energy,
Congress of the United States, Washington, D. C.

DEAR MR. DURHAM: Thank you for your letter dated January 20, inviting me to testify before your committee.

Enclosed you will find a written statement outlining my views. If anyone on the committee would like to ask me any questions, I would be only too glad to come down to the Capitol for the purpose. My presence here in Washington makes this only a matter of a phone call.

Yours sincerely,

NEWTON I. STEERS, JR., *President.*

STATEMENT OF NEWTON I. STEERS, JR., PRESIDENT, ATOMIC DEVELOPMENT MUTUAL FUND, INC.

Atomic Development Mutual Fund is an open-end investment company with assets in excess of $45 million. It was started 4 years ago with a capital of $100,000.

In selling our fund shares, I have occasion to be in close touch with the financial community throughout the country. In investing our shareholders' money, I have occasion to talk to officials of most of the companies active in the atomic-energy industry. Our company acts as a kind of conduit between the investing public and the companies in which we invest.

I have attempted to render the thoughts presented below in as unprejudiced a manner as possible. However, they do represent a point of view, and in interpreting a point of view it is always well to know which way the bias would run if it were not eliminated.

In my case, my political preference for free enterprise and the Republican Party goes back for more than 20 years. The proposals espoused call for additional governmental intervention. Consequently, it may be seen that the point of view presented was reached in spite of, and not because of, prejudice.

As I testified a year ago before the Joint Committee on Atomic Energy, we are losing our atomic leadership because an economic incentive is missing in the short run. I refer to the fact that at the present time, in this country, electric power cannot be generated as cheaply from uranium as it can from coal.

Before presenting suggestions on what should be done in regard to the electric power generating field, I would like to digress sufficiently to cover other parts of the industry. This is necessary because there is a very widespread tendency in the press and elsewhere to equate atomic electric power with atomic energy generally. This has led to a great deal of confusion, particularly as regards the financial health of the overall industry.

There are 3 segments of the industry which should be emphasized in this connection. These are the radiation instrument industry, the raw-material industry—principally uranium—and the propulsion reaction industry. It can be said that the established companies in all 3 of these segments are healthy and, furthermore, are growing rapidly. I would like to touch on them briefly before returning to atomic electric power. Each of these industry segments is, of course, in part related to the atomic electric power situation. However, each one, to a still larger extent, exists independently of the atomic electric power situation.

RADIATION INSTRUMENTS

The radiation instrument industry now has gross revenues of approximately $50 million or more annually. It is dominated by and almost exclusively consists of relatively small companies that were not even in existence 15 years ago. It is growing rapidly, and its healthy condition is substantial evidence that the fears that atomic energy would be monopolized by large companies were unfounded.

This industry will continue to grow for at least the following reasons:

(1) Growth in the use of radioisotopes is necessarily accompanied by a growth in the use of radiation instruments. Commissioner Libby has pointed out that the use of radioisotopes is currently saving United States industry and agriculture some $500 million annually and that this figure will increase 900 percent in the next 5 years, to approximate a figure of $5 billion annually at the end of that time.

(2) Experimental reactors and developmental work are growing rapidly, and both require increasing quantities of radiation instruments. Incidentally, when I refer to experimental and developmental work I refer to work of this sort both in the power field as well as in research work, more generally, not related to power.

(3) Radiation instruments must also be used in increasing quantities for propulsion reactors and for electric power generating reactors outside the United States.

PROPULSION REACTORS

At the risk of laboring the obvious, attention must be directed to the success of the submarine propulsion program. Money has been appropriated for 22 atomic submarines and funds for 5 more are under considerattion for fiscal 1959. With contracts awarded for a $300 million aircraft carrier, and an $88 million cruiser, and with design of a destroyer underway, the naval propulsion program can be described in glowing terms, even assuming that Senator Jackson's and Congressman Cannon's larger proposals are not adopted.

The aircraft propulsion program has changed too often to permit reliable evaluation. It seems evident that the industry's health will be enhanced in the near future if the Navy patrol "clunker" concept is adopted. The impact on industry will come later if the Air Force supersonic aircraft of advanced design concept is adopted.

Incidentally, I would like to register with this committee my feeling that the either-or approach to the problem is most unfortunate. It appears that the near-term and long-term concepts can and should be pursued simultaneously. It is true that the project has been studied to death, but I see no reason why inclusion of the Navy approach should require any delay, or, in deed, even any reconsideration of the Air Force approach.

This is particularly the case since, under existing procedures, development of both kinds of reactors would fall within the cognizance of the Atomic Energy Commission. Any mention of the propulsion program should include reference to nuclear-propelled missiles and the possible use of nuclear propulsion in space.

RAW MATERIALS

For the sake of brevity, I confine myself to uranium. Although a good many fears have been voiced on this score, Mr. Jesse Johnson, AEC Director of the Division of Raw Materials, has indicated domestic uranium ore production reached a new high in 1957, and 1958 will show the greatest increase in uranium production of any year in the industry's history.

Domestic uranium concentrate purchases by the Atomic Energy Commission were approximately $154 million in 1956 and $171 million in 1957. Purchases for 1958 are estimated at $247 million and for 1959 at $322 million, almost

double that of 1957. We have an expanding industry with an assured market at firm prices. The fact that the production rate is expected to level off is a far cry from the cutbacks which are so widespread in so many other mining and industrial fields at the present time.

Many commentators on the future of uranium have devoted their attention to estimating the uranium required for electric power generation and for propulsion. Weapons requirements have frequently been assumed to be zero. Naturally, no person not acquainted with the weapon production picture can intelligently appraise the demand for uranium for weapons, and those who are familiar cannot be specific. In the light of Chairman Durham's expressed feeling that our fissionable material production is inadequate and the fact that many other observers, impressed with the far greater versatility which atomic weapons are now known to have, feel likewise, I submit that zero weapons demand in the middle 1960's is the least plausible number which could be selected.

Personally, I would be willing for the sake of argument to assume that there will be a degree of uranium "indigestion" in the middle 1960's. I would still find it difficult to find an industry with better prospects than the domestic uranium industry with its ore guaranty until 1962 and its concentrate guaranty extending until the end of 1966.

The above observations should make clear how foolish it is to equate atomic power with atomic electric generally, and I now return to a consideration of the atomic electric power field.

ATOMIC ELECTRIC POWER

It is almost universally recognized that United States leadership in the atomic electric power field is made more difficult by our leadership in conventional electric power generation and our fortunate position in possessing large coal reserves minable at low cost. In a way, this fortunate possession of substantial coal reserves may turn out to be a curse instead of a blessing, as it is at the bottom of our presently dwindling world leadership.

A great deal of emphasis has been made on the idea that we should not indulge in a kilowatt race. I personally subscribe to this proposition. Unfortunately, not all the conclusions flow from it which are commonly assumed to. We should not, to be sure, pursue nuclear kilowattage for its own sake. For we certainly can build cheaper coal kilowattage. However, our proper objective will incidentally result in a very considerable increase in kilowatts of nuclear power capacity.

Those who have properly pointed out that kilowattage should not be our objective have perhaps naturally but mistakenly concluded that we should not actually build atomic electric capacity beyond the 1½ million atomic kilowatts which are presently projected in one form or another in the United States.

Our proper objective should be maintenance of world leadership and if this incidentally entails greater kilowattage than presently projected, then this higher capacity should be constructed. Loss of world leadership in atomic energy may have long-run consequences in terms of financial world relationships rivaling and even exceeding the truly staggering blow which we so unnecessarily suffered when the Russians captured world opinion with their dramatic and still unmatched satellite achievements. Demonstrated American technological leadership in the atomic field has played a vital role both scientifically and militarily in the endless diplomatic negotiation which has so precariously preserved peace.

But the importance in terms of world opinion may be dismissed by some as intangible and as inconsequential when compared with the more obvious military and economic realities which enter into the balance of power. I do not dismiss prestige either as regards our friends in the free world, or those on the fence for the time being in such countries as India, or as regards our enemies in Communist China and Soviet Russia.

However, for the sake of hypothesis, let us assume that world prestige is not sufficient justification for an increased program. I believe that even on economic terms we should increase governmental action. Specifically, I believe we should immediately press forward in the next 3 years with about half a dozen additional reactors of substantial size—100,000 kilowatts or more each—utilizing the Shippingport formula.

By the Shippingport formula I intend no reference to pressurized water and indeed I believe that the other major reactor concepts should be pursued. The point would be to have the Government absorb whatever extra cost there would be for the kilowatt-hours produced, above that which the utility in question would pay for production of conventional power.

Perhaps a natural qeustion would be, "Why build extra kilowattage if we are not in a kilowatt race, and if reasons of world prestige are insufficient?"

The answer stems from the development stage in which atomic power now lies. In a sense, this stage is a transitional stage between two other stages. Behind us lies the scientific revolution in which uranium was first demonstrated to be subject to a chain reaction. This engendered the conviction that atomic power will be cheap. Ahead of us lies the engineering development which is prerequisite to competitive power.

It is in negotiating the rocky road of engineering development that we see the need for building more reactors. Costs for atomic equipment are characterized by two qualities:

(1) They are high.
(2) They are uncertain.

It is obvious that volume production will help lower prices substantially and that is an important reason for building more reactors. It is obvious, too, that general development work on design or on material technology can lower costs. However, the present program calls for substantial general development, though not all the exigencies of the situation demand.

What should be equally clear is that volume production will not only lower costs, it will dispel the uncertainty. Estimates have been and are being made by the thousand. But no matter how detailed and careful they are, estimates are still estimates. They can be attacked and will be attacked by emotional people or prejudiced people or merely critical people. We have got to translate more of our estimates into hardware. We are doing a lot. We have got to do a lot more.

WHAT FORMULA TO USE

I have indicated a preference for the Shippingport formula. Perhaps my reasoning will be clearer if a couple of other proposals are analyzed.

For example, it has been proposed that additional reactors be built, keeping the proportion between private and public power the same as it is in presently existing plants. This has the worthy objective of side stepping the divergent attitudes which exist on this controversial issue. But what if the two segments want to go forward in differing degrees? In order to maintain the ratio, the more eager group would have to be curtailed to the goals of the less eager group.

Actually, it may be seen that the maintenance of the present ratio is not an alternative to the Shippingport formula. It could, though it need not, severely hamper the application of the Shippingport formula. Thus, for example, if the public power entities come to the AEC with additional Shippingport-type proposals, or could be induced to, and if the private entities did not come to the AEC, and could not be induced to, then the public power proposals could not be adopted, would have to be cut in order to maintain the required proportion.

I believe the controversy can be side stepped if the AEC cordially invites, and indeed exhorts, both types of entity to enter upon Shippingport-type arrangements.

The essential elements of the Shippingport formula, as I understand them, are—

(1) Government-owned reactor.
(2) Utility-owned generating equipment.
(3) Contribution to research and development by ability.
(4) Subsidized steam cost to utility.

Obviously, the contribution to research and development would depend on the resources of the utility, public or private, as the case may be. The AEC could, by exercising discretion judiciously, avoid any charge of favoritism in this comparatively minor sector. On the major items of the Government paying for the heat-generating reactor and selling the heat at less than cost, the opportunity would be open to all alike, public and private.

It may be objected that the Shippingport formula has been offered by the AEC and only so many takers appeared. To this, I think there is an answer. Remember the Duquesne Light contributed $5 million in research and development. This was about as far as a utility at that time could be expected to go and still fulfill its responsibilities to its stockholders.

And this is so, whether one conceives Duquesne to have been motivated by patriotism, progressive attitude toward a new technology, or just plain old fear that public power would otherwise grab the ball. It is a lot further than a utility or a reactor manufacturer can realistically be expected to go today.

Hence, the AEC's invitation and negotiation must be less demanding and the legislation should spell out the formula to be used accordingly.

Another proposal with much merit is that of subsidizing fuel costs. If carefully controlled, this might go far to get the necessary action underway. Unfortunately, it opens the door to a distorted technology. Subsidizing fuel costs down to a certain level—the Government paying the cost above a certain level—naturally will cause some designers to select low-capital-cost reactor systems. Clearly, this is not desirable since the lifting of the Government subsidy is an ultimate objective, and a low-capital-cost, high-fuel-cost reactor might or might not be a low-overall-cost reactor.

A feature of the formula recommended is that it should not distort technology. The Government subsidizes both capital cost and fuel cost. On the other hand, cash outlays by the Government are substantially reduced because of the contribution by the utility for its electrical generating equipment.

Once competitive power is achieved, the economic benefits to the country will accrue from domestically cheaper power and a new and important ingredient in our export trade balance.

In summary, then, it is submitted that a substantial additional program should be initiated by the AEC and that justification for it may be found independently in terms of ideological, psychological intangibles or in terms of ultimate economic benefits.

Together they afford a compelling and overwhelming justification. At least a half-dozen large reactors should be built and operated to preserve our technological leadership and attain competitive atomic power.

Mr. TOLL. Fifteenth: Letter dated January 27, 1958, to Chairman Durham from Mr. R. L. Doan, manager, atomic energy division of Phillips Petroleum Co., Idaho Falls, Idaho:

JANUARY 27, 1958.

DEAR MR. DURHAM: I appreciate your invitation to appear before the Joint Committee on Atomic Energy at the forthcoming public hearings on "development, growth, and state of the atomic energy" during the last 2 weeks in February. I feel sure that these hearings will be profitable and will form the basis for some sound legislation in those areas needing additional attention.

As you probably know, all of the activities of the Phillips atomic energy division in Idaho are being carried out under contract with the Atomic Energy Commission. In this capacity we see no major revisions or additions to existing legislation that are needed to enable us to do an effective job for the Government. It is true that Phillips, in common with other companies, would like to see some of the patent provisions of the Atomic Energy Act of 1954 more precisely defined and somewhat liberalized, but these are matters that others will no doubt cover adequately during the hearings. There thus appears to be no urgent reason why Phillips should have a representative at the forthcoming hearings, although we would be happy to participate if this should be considered desirable from the viewpoint of the committee. The subject of the hearings is an important one to all of us, and will, I am sure, merit the participation of everyone having substantial experience in the atomic energy field to the extent considered practical and desirable by the Joint Committee on Atomic Energy.

Very truly yours,

R. L. DOAN,
Manager, Atomic Energy Division.

Mr. TOLL. Sixteenth: A letter dated February 5, 1958, to Chairman Durham from Mr. J. S. Fluor, of the Fluor Corp., Ltd., Los Angeles, Calif.

DEAR MR. DURHAM: I sincerely regret the long delay in answering your letter of January 20, 1958, inviting me to appear before the Joint Committee on Atomic Energy which is to convene February 18 or 19.

It was the opinion of our executive group that, because of our limited activity in the atomic energy field, we would not be able to substantially contribute to the hearings, so I will not plan to attend. However, as you suggested, we would like to express our opinion with reference to the construction of atomic energy powerplants.

We believe that the interests of our Nation would best be served by a vigorous and extensive research and development program, including the installation of small or pilot plants rather than full-scale commercial powerplants. Full-scale installations, built with present know-how, are not essential or competitive. We further believe that with an accelerated research program new technology will shortly be acquired so that powerplants could be constructed at a cost that would closely approach the present-day steam electric units that use fossil fuels.

We hope that our work in this field will expand in the future so that we can be more helpful in promoting the growth of this vital industry.

Sincerely yours,

J. S. FLUOR.

Mr. TOLL. Seventeenth: A letter dated February 5, 1958, to Chairman Durham from Mr. Clifford S. Strike, president of F. H. McGraw & Co., contractors, New York, N. Y.

DEAR MR. DURHAM: Thank you very much for inviting me or a representative of our company to testify before the Joint Committee on Atomic Energy, or to submit a statement for the record.

I wish to make the following statement for the committee's consideration:

"To our knowledge, management and direction of continuous research (together with its accompanying tasks) is not being performed at present.

"A group should be formed having knowledge of all available classified and unclassified know-how, and should obviously be a special AEC group. Its function would be to allot continuous research and special tasks to existing groups of engineers. These engineers should have accomplished something unusual in research because of their know-how, and be familiar with the work required.

"Since the high cost of atomic reactors is dictated by very stringent specifications, it is possible that one of the phases of continuous research could be utilized toward its reduction."

Mr. P. F. Rape, our representative in atomic energy matters, will attend some of the hearings.

Sincerely,

F. H. MCGRAW & CO.,
CLIFFORD S. STRIKE, *President.*

Mr. TOLL. Eighteenth: A letter dated February 19, 1958, to Chairman Durham from E. J. Longyear Co., signed by Philip L. Merritt.

DEAR MR. DURHAM: We who have been following the atomic energy raw materials program over the years are deeply concerned with the revised procurement policies of the Atomic Energy Commission as outlined by Mr. Jesse Johnson in his speech before the Atomic Industrial Forum on October 28, 1957. The Atomic Energy Commission can well be proud of the policy it pursued during the past 10 years, for under that policy the incentives offered were responsible for building a strong, healthy, domestic uranium mining industry. You are no doubt familiar with these accomplishments, but they may be worth repeating. Under this program our domestic ore reserves rose from a million tons and a production of a few hundred tons of U_3O_8 in concentrates, 10 years ago, to a reserve of some 75 million tons and a production of about 8,500 tons of U_3O_8 in concentrates in 1957. Present Commission commitments would indicate that our annual domestic production rate should rise to 18,000 tons of U_3O_8 within the next 2 years. Similar spectacular accomplishments were attained by the Commission in its foreign procurement program—particularly in the Union of South Africa and in Canada.

Many of us in industry now have misgivings as to the effect of the new Commission program on the raw materials industry and the future of the country's uranium reserves. As you no doubt know, the production program of the Commission will permit the delivery of concentrates to the Commission, from present domestic reserves and under present milling contracts, for less than 10 years. On the other hand, the reserves developed in Canada and South Africa are sufficient for a continuation of production for a score or more of years. The ratio of our production to reserves is far lower than in the other major producing areas of the world.

There is general agreement in the uranium industry that the new Commission policy will reduce the incentives in exploration, with the result that, barring fortuitous discoveries, our ore reserves are likely to decline seriously during

the next 10 years. Except for production under current contracts, the Commission's procurement policy, as announced late in 1957, has largely removed the incentives of long-range venture capital in the development of reserves for the future. The present strength of the industry cannot be maintained over the years unless an exploration incentive exists.

The Commission, during the next several years, is the only purchaser of uranium in a position to give the kind of support that the uranium mining and milling industry needs in order to maintain its strength. Although we all look forward to the time when a commercial market for uranium is established, it is obvious that the nuclear power industry will not be in a position to offer substantial support to uranium producers in the near future. If our Government is concerned with the maintenance of a healthy domestic industry to support both the military and peaceful uses of the atom—an industry whose long lines of supply would require no protection during times of strife—then ways and means should be sought to accomplish this end.

As my first suggestion, I believe that the surest manner for the Commission to maintain a healthy raw materials industry based upon adequate long-range ore reserves would be to revert to the procurement policy that was recently abandoned. This would entail the granting of milling contracts to provide markets for new ore as discovered and developed. Of course such a policy will result in further Commission commitments above the present level—depending upon the successes in exploration. There may well ge overriding reasons for the Commission to avoid additional excessive expenditures for raw materials during the next decade. It would seem to me, however, that the uranium purchased above and beyond the definitive needs of our country could well be stockpiled in a convenient form, prior to enrichment, thus saving the taxpayers the vast expenditure required for enrichment until such time as the enriched material is required.

It has occurred to me that other steps might be taken by our Government to maintain a healthy industry and encourage the continued development of reserves—whether in old or new mining districts. These steps, while perhaps not so costly to the Government as reinstatement of the recently abandoned successful procurement policy, should tend to encourage the flow of venture capital into the industry.

I offer these additional suggestions for your consideration:

1. Liberalize the Defense Minerals Exploration Administration program. Venture capital might be encouraged to continue exploration on a large scale in DMEA, or a similar program carried out through the use of Atomic Energy Commission funds, would increase the present Government assistance to exploration well above the 50 percent rate now pervailing in the case of uranium. Likewise, a longer period of payback to the Government would increase the likelihood o fthe Government's recouping its capital. Venture capital thus might be willing to leave its money in the ground for a longer period of time than under present contract terms.

2. Encourage the development of reserves which would remain in the ground until needed. Under a program of this type, the Government could perhaps purchase, or partially purchase, ore in the ground at a rate sufficient to repay venture capital for its exploration and development cost.

3. Encouarge the development of a commercial market for uranium. Mr. Strauss, in his speech before the Atomic Industrial Forum in October 1957, envisioned an esentially civilian power industry in a decade. On February 7, Mr. Johnson, in a speech before the Colorado Mining Association, made an announcement which would indicate that the Commission was about to permit commercial sales of uranium to licensees. It is, of course, too early to determine the effect of this announcement on the industry. Admittedly, the lack of encouragement and the difficulty in the development of a commercial uranium market may in part be due to our tendency to utilize enriched uranium in power-reactor designs, thus necessitating the utilization of Government-owned facilities. This may not be a valid reason, as the Commission could probably enrich privately owned uranium on a toll or custom basis. Such a procedure is common in many phases of the nonferrous metal industries.

The Commission, in its first three rounds of requests for reactor proposals, has apparently preempted the major share of any domestic commercial market that may develop during the next decade through the "waiver of use charges" for nuclear materials for a period of 5 to 7 years after the reactor facility is licensed to operate. Also, in the foreign field, the Commission has made commitments to furnish nuclear materials to certain foreign governments and inter-

national organizations on a sale or lease basis. The question naturally arises, does the Commission procure uranium for other than military and research purposes, or does it intend to furnish out of its stocks all of the uranium, whether natural or enriched, required by the atomic power industry, both here and abroad? It seems to me that the uranium raw materils industry has a vital stake in the ultimate utilization of uranium which the Commission procures.

The "waiver of use charges," is another form of assistance to the infant nuclear power industry supplementing other research and development help which the Commission has agreed to give to prospective reactor builders. Admittedly, assistance to private industry in the development of economical power reactors is essential at this state, and every possible encouragement must be given if the job is to be done. I wonder if equivalent assistance could be given to the power industry in some other form, thus enabling the direct sale of raw materials both here and abroad by the uranium industry.

The question arises as to whether the Commission has given consideration to the deleterious effect of the "waiver of use charges" on the establishment of a commercial uranium market and hence on the health and stability of the domestic uranium mining and milling industry. Obviously, the nuclear power industry cannot long exist without a strong raw material industry.

I hope, in submitting my views to you, that you will take them in the spirit in which they are given—for I have a genuine interest in the maintenance, over the long pull, of a strong raw materials industry upon which this Nation may depend for both its military and industrial uranium needs. I know that you and the Joint Committee on Atomic Energy are also vitally concerned with the basic problems involved, which, admittedly, are complicated.

Yours very truly,

PHILLIP L. MERRITT.

Mr. TOLL. Nineteenth: Letter dated February 13, 1958, to Chairman Durham from Mr. Fred W. Hottenroth, vice president, technical products, the Hupp Corp.

MY DEAR MR. DURHAM: We appreciated your letter of January 20 inviting us to testify before your committee during this year's hearings. We have, however, carefully reviewed the suggested topics for discussion and it does not seem to us that our problems are particularly fitting in the group of topics listed.

At this time last year, we were considering entering the field of manufacture of heavy water. We submitted a statement on the subject in which we indicated the problems encountered in dealing with foreign inventors and acquiring patent rights to foreign inventions for manufacturing in the United States.

We lost interest in this program. One of our principal reasons is because the laws which limit patent rights and require licenses for operation of manufacturing facilities of heavy water under the Atomic Energy Act seriously impair the business values of the exclusive United States rights that could be acquired. They make commercial ventures into the atomic energy field quite hazardous and questionable from an investment viewpoint.

Since we have discontinued further action on this heavy water program, we do not feel that we can consider ourselves in a position where we could make other than sideline recommendations. We do, however, appreciate your thoughtfulness in inviting us to testify before you. If at any time in the future we feel that we have anything constructive to suggest, we will again be in touch with you.

Yours very truly,

FRED HOTTENROTH,
Vice President, Technical Products.

Mr. TOLL. Twentieth: A letter dated February 27, 1958, from Mr. J. S. Hoover, president of the Canton Chamber of Commerce, Canton, Ohio.

DEAR CONGRESSMAN DURHAM: As chairman of the Joint Committee on Atomic Energy, you and your fellow members deserve sincere congratulations and thanks for your interest in obtaining public comments in connection with the scheduled section 202 hearings.

The national affairs committee of the Canton, Ohio, Chamber of Commerce, is vitally interested in the development of the atomic-energy industry in the United States. We believe it absolutely essential that peaceful use of atomic

energy be developed by private industry, in accordance with the American concepts of free, competitive enterprise which have been traditional since the 18th century.

We are alarmed by recent extravagant comments and statements made by public power proponents, both in and out of the Congress. They contend certain nations are ahead of the United States in the development of electric power from thermonuclear sources.

Our committee has made a factual appraisal, an objective analysis, and an honest evaluation. Frankly, this comprehensive study does not support such a contention. Quite the contrary, for it shows that atomic electric power developments in these United States are not only sound and practical, but promise to keep us abreast, if not ahead, of any other nation.

Advocates of Federal development of atomic power claim a Government "crash" program is essential if we are to match the estimated installed kilowatts planned in Great Britain and Russia.

An objective based primarily on an installed kilowatt basis is not realistic nor is it sound. It ignores the economic truism that atomic energy is not competitive in cost with conventional sources of energy at this time. Actually, the most optimistic reports estimate it will be from 6 to 10 years before an atomic plant can be developed to be even competitive with today's conventional plants.

Equally important is the fact that the proponents of a Federal Government "crash" program ignore our Nation's abundant supply of low-cost fossil fuels—much of which is located in, or adjacent to, the country's leading industrial areas where not only the most electric power is used now but will continue to be in the future.

It is evident these advocates pay little, if any, heed to the fact that in 1956, the United States, with 6 percent of the world's population generated more than 40 percent of the world's electricity—almost 4 times that of Russia and nearly 7 times that of Great Britain.

Our facts, also, indicate the only areas of our country that face or fear electric power shortages are those whose supply depends upon some Government subsidized source.

There is no industry with a record of real accomplishment which surpasses that of our Nation's private electric companies. Not only have they kept ahead of every demand made of them, but they have been able to maintain, simultaneously, low, reasonable rates. Never have United States citizens received so much for so little.

Therefore, we recommend to the Joint Committee on Atomic Energy the following objective: Make certain that the United States will lead on the broad base of superiority in technical knowledge and competence which will establish world leadership on the firm foundation of actual progress toward reducing the cost of atomic power.

We believe that private enterprise can and will achieve this sound objective. A survey by the Edison Electric Institute reveals that by the end of 1959, private utilities in the United States will have spent more than $231.8 million for nuclear power development. This total includes $80.2 million spent during 1957, $59 million which will be expended this year and $92.6 million planned for 1959. Total cost for 12 atomic powerplants in operation, under construction or planned, not including operating expenses, has been estimated at $480 million. The total number of United States reactors completed, under construction or in the planning stage as of December 31, 1957, totaled 237 for all purposes.

Critics of private enterprise development believe that private enterprise cannot handle the tremendous losses which are expected to be involved in the construction of reactors required within the next few years. Although they may be sincere in their belief, this does not, as a matter of course, demand a Government reactor construction program.

Instead, it points up the need for a program of Government help in the construction of privately owned reactors. This will accomplish the economically sound objective which we have outlined.

Government help to private industry—and not outright construction and ownership—will keep us ahead of Communist Russia and socialist-trended Great Britain. This can be accomplished without sacrificing the great American heritage—which we are actually trying to preserve—the freedom and dignity of the United States citizen.

J. S. HOOVER, *President.*

Chairman DURHAM. The committee is adjourned. We will hold the record open for further letters and statements received by the Joint Committee prior to April 1, 1958.

(The following letters and statements were received for inclusion in the record:)

COLUMBIA-NATIONAL CORP.,
Cambridge, Mass., February 14, 1958.

Mr. DAVID R. TOLL,
Joint Committee on Atomic Energy,
Capitol Building, Washington, D. C.

DEAR MR. TOLL: In connection with the proposed hearings of the Joint Committee on Atomic Energy, I enclose a statement which expresses the thoughts of our company relative to certain problems which must be faced by Congress in its attempt to effectively develop an atomic energy program in this country.

I have informally discussed this subject with both manufacturers of raw materials and equipment for atomic energy. We would welcome an opportunity to discuss this subject in greater detail with Congressman Durham or members of his committee.

Very truly yours,

RICHARD S. MORSE.

STATEMENT OF RICHARD S. MORSE, PRESIDENT, COLUMBIA-NATIONAL CORP.

GOVERNMENT SUPPORT OF THE DEVELOPMENT OF COMMERCIAL ATOMIC POWER

The United States civilian atomic power program was initiated in 1952 with the objective of producing competitive electric power from atomic energy in a reasonable period of time. Much progress has been made. The accomplishments to date have clearly established the technical feasibility of producing electrical power from atomic energy. This work has also shown, however, that competitive power is more difficult to attain than was originally expected and that Government support to the atomic industry during the development period is necessary for vigorous prosecution of the program. It is essential that the Joint Committee on Atomic Energy and the Atomic Energy Commission clearly define the objectives of the United States program and that Government support be supplied in such a manner that these objectives will be attained.

There are of course various ways in which Government support might be supplied to industry and we believe that certain pitfalls must be avoided. The principal objective of any such Government program should be to develop power-producing reactors which will ultimately produce electrical power from nuclear fuels competitively with other production methods.

The types of reactors which may be ultimately developed will depend very much on the form in which incentives are established by the Government in its effort to expedite the establishment of an atomic energy power industry. If the incentives are not reasonable and realistic, then much of the time and effort to be expended in reactor development will be wasted, and this country may end up with either obsolete or uneconomical type of reactors either for use here or abroad. In addition, business enterprises, founded during the period of Government support, will not be on a sound, economic footing when Government support is withdrawn. Those segments of the industry which could be affected adversely are raw-material suppliers, component manufacturers, nuclear-design organizations, and power producers.

Many American companies have invested their own funds for the production of materials and supplies important to the nuclear-energy industry. Columbia-National Corp., for example, has over $11 million of private capital invested in a plant in Pensacola, Fla., for the sole production of hafnium-free zirconium for use in nuclear reactors. Government aid for an accelerated development of commercial, competitive power reactors should be furnished in a way which will lead to the design of reactors compatible with an entirely free, independent, and unmanaged economy. From the viewpoint of the President's atoms-for-peace program, American industry may lose its competitive advantage abroad, where the requirements of other countries are based on sound, economic considerations insofar as their selection of a given reactor design is concerned.

At least 10 factors, now under direct Government control, directly or indirectly influence the designs of reactors now being developed. These have a direct bearing on operating and capital costs:

Operating cost

1. Price of natural uranium
2. Price of enriched uranium
3. Rental charge on uranium
4. Buy-back price for plutonium
5. Price of heavy water
6. Reprocessing charge for spent fuel elements
7. Waiver of fuel charges
8. Waiver of charges for heavy water

Capital costs

9. Contribution to capital costs
10. Contribution to research and development costs

If the prices for the first six factors are established on any basis other than those which would prevail in a free economy, the reactors ultimately developed will not be of optimum design for competitive use in a free-enterprise system.

For example, the prices of uranium should be set by the Government at a sufficiently high price so that, if the demand ultimately warrants it, private industry will be interested in investing its capital in the facilities required to produce both natural and enrched uranium; this means that the prices must be high enough to generate a reasonable return on the capital invested in the enterprise. If this is not done, and if the price of uranium is lower than that which would prevail on a long-term basis in a free economy, reactors will be designed which tend to be wasteful of the uranium fuel. That is, the quantity of uranium consumed per kilowatt of power generated will tend to be higher than should be the case. As another example, a buy-back price for plutonium which pays more than it is really worth will influence the design of a reactor in the direction of putting the fuel through it rapidly in order to increase the yield of plutonium; this may not be an economic procedure in the long run.

We believe that the present charge of 4 percent on the value of the uranium tied up in a reactor operation is too low, as industrial concerns today cannot borrow money at this rate; in effect, the Government, through this low interest rate, may be subsidizing the development of reactors which carry excessive inventories, have too high an enrichment, or result in a slow processing of fuel leaving the reactor. Similarly, a waiver of fuel charges, or of charges for heavy water, may cause the designer of the reactor to be wasteful of these materials.

To date, most of the Government support has been in the form of a waiver of fuel charges, a contribution to capital costs, and/or a contribution to research and development costs. We believe that contributions toward capital costs and to research and development costs may result in the development of reactors with excessively high capital investment per unit of electrical energy generation capacity.

It is our considered opinion that the most effective, and, perhaps, the only way in which Government support can be given without distorting reactor designs is to contribute to each utility or reactor owner (not builder) a sum based on the capacity of the nuclear-fueled powerplant, or to its output over some arbitrary period, say 5 years. (In essence, these are essentially the same bases, inasmuch as utility powerplants tend to run at a fairly consistent load factor over an extended period.) With this contribution, the owner-operator of the power-generating utility has entire freedom to look over the designs of the several reactors offered for sale to him and to make his own selection as to the optimum design, balancing capital investment, and operating costs over the life of the unit. This means that, to satisfy their customers, the utilities, designers, and builders of reactors will strive to design reactors which will produce power at minimum costs, considering both amortization of capital investment and out-of-pocket operating costs. The period of time and the quantity of support by the Government will be minimized by thus maximizing the incentives to private industry; when Government support is no longer necessary, it will be found that the atomic-power industry will be established on a sound, competitive, economic basis which needs no continuing artificial subsidies or price supports.

It should be recognized that, at this early stage in the atomic-power program of this country, research and development costs are very high and are a major deterrent to greater participation by industry. Some Government support for worthwhile private industrial research projects, directed toward the development of new types of nuclear reactors, is needed at this time. It should, however, be withdrawn as soon as possible, leaving as a principal incentive for private industry the development of reactors capable of generating electrical energy at minimum cost.

American industry has invested very substantial amounts of private capital in the hopes that atomic energy will ultimately be a profitable business. We clearly recognize the international importance of atomic energy and the contributions of all nations to developments in the field. We are, however, greatly concerned that our Government may, under the guise of our foreign-aid programs, establish producers of equipment or raw materials abroad who will have a preferred position versus their American competitors for markets in the United States.

GENERAL DYNAMICS CORP.,
New York, N. Y., February 27, 1958.

Hon. CARL DURHAM,
Chairman, Joint Congressional Committee on Atomic Energy,
Capitol Building, Washington, D. C.

DEAR MR. DURHAM: Reference is made to your invitation to me to participate in the 202 hearings which are being conducted under your chairmanship. I must be out of the country at the time of these hearings and, consequently, cannot avail myself of the opportunity to appear before your committee. However, Dr. Frederic de Hoffmann, a vice president of General Dynamics Corp. and division general manager of general atomic division, will testify on March 3.

I do wish to take this opportunity, however, to reduce to writing some of our thoughts within the corporation on the role of research in industry.

Economic nuclear energy requires a new systems approach. As is becoming increasingly evident, research and development to bring about truly economic nuclear power rests upon a far wider set of disciplines than is commonly found in the manufacture of other technological products. Only the proper interplay of the basic sciences, engineering, and production know-how can bring about the rapid progress our Nation desires.

This was amply illustrated during the last war when another area of nuclear work, the atomic bomb, was so successfully undertaken by the close cooperation among theoretical physicists, experimental physicists, chemists, metallurgists, engineers, and dedicated men with production know-how. Today, the problems of nuclear power are likely to be solved only by calling on the same kind of intense coordinated and dedicated effort. In addition, we must insure that this process is carried out within financial structures of sufficient breadth and vision, depth and strength, to let these efforts proceed most effectively. At the same time, we must insure that these structures are within keeping of the traditional goals of free American society.

While the problem as a whole is complex, I would like to address myself to one aspect of it; namely, that of the role of research and development in this field by industry. Let me examine the proper role of industry in the research and development effort in atomic energy in the context of the above remarks. Generally, when we think of pure research, we automatically think of the university, since, traditionally, the role of the university is that of teaching and advanced research. Traditionally, too, we think of industry as applying existing technical knowledge to produce goods of current use. If we further delve into the mechanisms of the modern university, we find that it tends to be a set of highly specialized departments where research is proceeding within the frontiers of given fields. While this is as it should be, it cannot and should not form the framework for undertaking fundamental research in the complexities of a technological system which one is trying to create with deadlines in mind. I say "should not" because I believe that the most fundamental role of a university must be that of outstanding education and that a university must not lose its high educational standards in the race to produce present-day complex technological products. The national laboratories of the United States Atomic Energy Commission have tried to bridge this gap between pure research and applied technology to a certain extent. However, it is my firm belief that this is merely a step in the right direction, but not enough. Industry itself must make real contributions toward

coordinating properly the complex interplay of scientific disciplines, engineering, and production know-how. Only in this way in the complex problem of reactor technology will there then be the proper continuity to the production know-how and production capability of American industry.

I strongly urge, therefore, that American industry as a whole accept this challenge to broaden its base by creating the proper research and development atmosphere within certain parts of a structure and by giving it adequate support. Equally, I urge that, on the part of Congress and the administration, such efforts be welcomed as an indication of new strength in our overall national system toward creating economic atomic nuclear power, and that the proper support be given to it from these quarters.

We in General Dynamics Corp. recognized this new responsibility of American industry some years ago. Our realization resulted in the creation of the large company-funded John Jay Hopkins Laboratory for pure and applied science within our general atomic division. I am pleased to be able to report to you that this laboratory is now a vigorous enterprise, proving out what we believe to be some of the concepts which will make for the proper interplay of science and industry.

I believe that industrial laboratories of this kind will be able to shoulder for the Nation, not only complex research and development programs leading to a particular prototype, but also to undertake effective research in wide areas of reactor technology. By this I mean that a certain class of problems, the solution of which is equally applicable in many reactor types, be attacked. New industrial organizations which do, indeed, combine the best traditions of the freedom of academic research with industrial vigor and know-how are proving that they are able to make a real contribution toward the solution of such across-the-board problems as creation of physically new fuel elements, the broad question of controlling reactors, behavior of materials under irradiation, and even controlled thermonuclear reactions.

It is essential that we recognize that such broad classes of problems must be attacked within the proper industrial framework. Industrial organizations to date are often called in to search for the solution to a specific problem. The time has come when we must use the proper industrial organization in an increasing measure to make progress in a whole area, so that specific systems, such as reactors, can readily be pieced together from such solid foundations.

To this end, I believe it is essential that the Congress make available to the United States Atomic Energy Commission greatly increased research and development funds. Substantial funds with a minimum of restrictive provisions could then be channeled to those industrial laboratories of the country who are anxious to accept the challenge and provide the facilities and capabilities to carry out this new type of atomic-energy research effort required within industry for our national growth.

Sincerely,

FRANK PACE, Jr., *President.*

STATEMENT BY THE MEMBERS OF THE STAFF OF THE DEPARTMENT OF SANITARY ENGINEERING, SCHOOL OF PUBLIC HEALTH, UNIVERSITY OF NORTH CAROLINA, CHAPEL HILL, N. C., FEBRUARY 5, 1958

As public-health workers and educators, we have a concern for the protection of the public from the dangers of overexposure to ionizing radiation. The margin of safety between acceptable dosages of radiation and the exposure of the public will narrow as the atomic-energy industry expands. As this margin narrows, more intensive surveillance will be necessary to protect the public properly.

By law, health departments at all levels are charged with the responsibility for the protection of the population from all forms of health hazards, including radiation. Thus, these official health agencies are required to share responsibilities of this nature with the Atomic Energy Commission. The assumption of these responsibilities implies that persons of proper education in matters of public health and atomic energy are available to conduct such work. An adequate number of such persons is not available at the present time.

Commendation should be given to the Atomic Energy Commission, the Public Health Service, the Department of Defense, and other Federal agencies for their own educational and training activities in the field of atomic energy. They have shared generously with their time and energy to assist in the educa-

tion and training of other persons; however, these agencies are not, primarily, educational institutions.

Therefore, it is suggested that the Joint Committee on Atomic Energy of the Congress of the United States take note of the responsibilities of the health agencies and of the limited number of properly educated and trained public-health personnel who can be charged with the technical responsibilities associated with the atomic-energy field. It is further suggested that the Congress financially assist educational institutions to acquire the staff and facilities for the education and training of such personnel. Universities with schools of public health are well suited to conduct these activities because of their ability to bring together faculty resources in physics, chemistry, and biology with those in public health.

THE NEW YORK PATENT LAW ASSOCIATION,
New York, N. Y., March 3, 1958.

Hon. CARL T. DURHAM,
Chairman, Joint Congressional Committee on Atomic Energy,
House of Representatives, Washington, D. C.

DEAR MR. DURHAM: Representatives of the New York Patent Law Association have several times in the past appeared before or submitted statements to your committee or its predecessor committees relative to the 1946 and 1954 Atomic Energy Acts. Each of these appearances and statements has been presented with the objective and firm belief that, as fully and promptly as possible, patent matters in the atomic-energy field should be governed by the same principles of patent law applicable to all other fields of discovery and invention.

It is the belief of the board of governors of the New York Patent Law Association that the 1954 Atomic Energy Act contains several provisions which, in philosophy and operation, are in opposition to factors which have made the United States patent system such a successful part of our economic system. These have been the cause of considerable concern to the members of our association, as well as to many other lawyer groups.

For example, the Constitution requires that the inventor receive the patent. The first sentence of section 152 of the act as it now stands runs contrary to the Constitution in that it provides that the Commission "shall be deemed to have made or conceived" the invention. This device to provide for control by the Commission is not necesary in any event, for the Commission can obtain title to those patents to which it is entitled by express or implied contract relations, such as is done, for example, in contracts with the Defense Department. Accordingly, this association recommends that the first sentence of section 152 be eliminated.

This association also recommends that section 152 be amended to clarify the status of inventions which may be subject to acquisition by the Commission under the controversial phrase "arrangement or other relationship" with the Commission. Even though the Commission has, from time to time, announced that a party who understakes certain activities or who acquires certain permits will not be deemed to have an "arrangement or other relationship" with the Commission, this phrase remains so broad and indefinite as to put in serious doubt the title to inventions developed by those who have had only the remotest connection with the Commission. The association urges the Joint Committee to consider amendment of this provision of the 1954 act so as to limit the Commission's right to acquire only those inventions involved as the result of "a contract, express or implied, entered into with the Commission for the benefit of the Commission".

Section 153 of the 1954 act provides in effect for the compulsory licensing for the benefit of either the Government or private enterprise of any patent for "the production or utilization of special nuclear material or atomic energy". By its terms, the section applies only to applications filed prior to September 1, 1959. In actual practice, however, the effects of the compulsory licensing provision will linger for 20 years and more, for an application filed prior to September 1, 1959, may not issue as a patent for several years after that date. When issued and for 17 years thereafter it always would be under the threat of compulsory license.

The constitutionality of section 153 is certainly questionable, for, by it, the power of the Federal Government to condemn property for its own use is extended to the condemnation, in effect, of private property for the use of private citizens.

An even more serious criticism of section 153 is that it undermines a most vital factor in making operative our patent system, and that is incentive The atomic field is so highly speculative, the cost of entering the field in time and money proportionately so great with respect to the resources of a given company, that many companies would expect to get no return except for the possibility of patent rights which, because they extend for 17 years, might pay off ultimately. The Commission may, by following the compulsory licensing procedure of section 153, direct that these patent rights be shared with others. The incentive to create in the atomic field is diminished. Moreover, the factors which incline inventors to delay publication of their inventions are much the same as if there were not patent system at all. Without prompt disclosure of new knowledge to stimulate further creative efforts by others, different and better inventions for the public welfare are delayed.

We do not believe that compulsory licensing is justified by the fears, sometimes expressed, that some patent may come along to strangle the atomic energy industry. There is no historical support for the belief that a strangulation situation might exist. And it has been the case time and again that an attempt to overreach by use of a patent has stimulated inventors to find a different and better process or device to accomplish the same end.

Section 155 of the act also requires modification. In its present form section 155 is contrary to established patent law and procedures because it makes effective as prior art subject matter which has been held secret and which may well never be otherwise disclosed to the public simply through administrative oversight. Progress in the atomic energy field is not aided by this section. It is suggested that section 155 be amended to require that for such material to be considered as prior art it must, at least, have been published by the Technical Information Service of the Commission. As such it may still be classified and subject to all reasonable safeguards of the need-to-know principle.

We respectfully commend the foregoing to the attention of your committee.

Very truly yours,

HENRY R. ASHTON, *President.*

PIONEER SERVICE & ENGINEERING CO.,
Chicago, Ill., March 3, 1958.

Hon. CARL T. DURHAM,
Chairman, Joint Committee on Atomic Energy,
Congress of the United States, Washington, D. C.

DEAR CONGRESSMAN DURHAM: At your kind invitation of January 20, 1958, Pioneer Service & Engineering Co. again feels privileged to present its views with respect to the development, growth, and state of the atomic energy industry. We wish to do so by means of this letter and will confine our observations to the atomic power program and to certain aspects of the Atomic Energy Commission's contract policies in the atomic power development field.

The founder of our organization participated in the design of the first steam-operated electric central station in the world, the Pearl Street station. Thus we have spanned the years of the dynamic progress in the electric power industry in this country as design engineers and construction managers, filling a role of a middleman between electric utilities and producers of powerplant equipment. We have seen the constant evolution of better and bigger equipment and higher efficiencies in the United States.

No other nation in the world has a supply of electric power comparable to that of the United States. We have more electric power capacity than the next six countries combined, namely, Russia, Great Britain, West Germany, France, Canada, and Japan. With only 6 percent of the people, the United States has 36 percent of all the electric power capacity in the world and produces 41 percent of the world's kilowatt-hours. This higher production in relation to our capacity is due to various factors and not the least of these is better utilization of the results of continuous research. We attained this position and are maintaining it by the sound progressive application of our research to our growth which has occurred just as fast as our economy would support it.

Our steady advances in this country in technology in the production, transmission, and distribution of electric energy have been available continuously to the rest of the world. Without doubt, these advances have been of international benefit. There has been substantial growth in electric power production in the

rest of the world too, but, like our own growth, it obviously has been no more rapid than the supporting economies would warrant. With limited exceptions, we know of no dynamic economies in the other countries of the world now which would permit them to surge out ahead of the United States in the development of their electric power facilities.

This brings us to our views with respect to the atomic power program. We have been participants in this program since October 1952 when, with others, we entered into a study contract with the Commission. Presently, we are identified as architect-engineers and construction managers with the Pathfinder atomic power project. Devoting our time and efforts to this project without pecuniary profit is our manifestation of a sincere interest in the future of atomic power.

We believe that the continued sound progress in the atomic program must be supported by a steadily growing base of economic and technical information. This, in our opinion, can be accomplished best by allowing for the full fruition of the 5-year program and continuing the reactor development program as presently conceived coupled with an expanded program of research and development centered around the existing facilities of the Commission. Such an approach will be of benefit internationally as well as domestically.

In an appearence before the Joint Committee shortly after the 5-year program was announced, we expressed the view that it was well conceived and we are stronger of that opinion today. The validity of the concept is now being borne out by the experience and knowledge we have gained and are continuing to gain from the design and construction of a variety of types of reactors. Some of these reactors are already in operation and others will be in time. This program is arriving as contemplated and is bound to provide us with a great deal of well advanced data. We would be very wise to await the significant results and apply them in an orderly manner.

Under the reactor demonstration program and concurrently with it, we have a very creditable number of full scale atomic powerplants under construction or committed with others in prospect. These are coming into being in keeping with the traditional and effective history of the development of electric power in this country which has made us the world leader in this field. Large sizes in plants are not necessary to produce the needed information. The electric industry in this country made its technological progress by steady developments from small beginnings. In our opinion, an accelerated program for building large scale atomic powerplants would be wasteful if it does not allow adequate time for proper evaluation and recognition of the status of the technology associated with each type. Let the construction and operation of full scale power reactors follow the presently established pattern and progress in step with the development of the necessary technical and economic information. We can do this and provide the desired leadership internationally in the doing. We are well ahead with our atomic power program on a broad front and are in a position to show other countries of the world the way as rapidly as their economies will support expansion of their electric power facilities. The Three Wise Men have said as much.

Our world position would be enhanced further by the expansion of our research and development activities. This is an area in which the Commission is appropriately organized and equipped and in which funds available for the atomic power program could be employed most productively for the good of the domestic program and the international program as well.

We believe it is important that aid be continued as at present under the reactor demonstration program and that the national laboratories continue their present programs, but we also strongly urge a considerably broader effort with respect to atomic fuels and materials testing. The emphasis of the Commission should be directed toward the fundamental problems that contribute to the high cost of atomic power irrespective of a particular type of reactor. These include fuel technology, materials, reactor safety, chemical processing, and radioactive waste disposal. Development of better techniques, equipment, and basic information in these areas will do more than anything else to bring economic atomic power closer to reality.

It is only logical that the Commission perform the large part of this research and development work. It already has millions of dollars invested in basic research facilities and is organized to direct the work in the necessary expansion of existing facilities. Furthermore, because of the military aspect of atomic fuel, it is essential that governmental control be retained. Under those circumstances, the Commission should play the leading role with the fullest cooperation and assistance from industry.

In conjunction with this approach, we believe that the Commission's contract policy should be directed toward encouraging participation of the engineering and manufacturing firms in the area of fundamental technology. This cannot be done by bargaining for lump-sum contracts where the scope of the work is subject to change as the problem is explored which is so apt to be the case in this experimental field. We believe that the best results from the viewpoint of all concerned can be accomplished by a cost as low as possible yet recognizing that the unknowns at the outset must be adequately evaluated during the terms of the contract. We speak from experience in this regard.

Thank you for your indulgence. We have endeavored to express our sincere opinions herein and hope that they may be of assistance to you and your associates on the committee.

Respectfully submitted.

FRED C. KELLOGG, *President.*

ALLIS-CHALMERS MANUFACTURING CO.,
Washington, D. C., March 3, 1958.

Hon. CARL T. DURHAM,
Chairman, Joint Committee on Atomic Energy,
House Office Building, Washington, D. C.

DEAR MR. DURHAM: The following statement is submitted for your committee's consideration for the record of the section 202 hearings.

With the full cooperation of the Atomic Energy Commission, contracts were formally completed the latter part of 1957 for the Northern States Power Co. 66,000-electrical-kilowatt, controlled-recirculation boiling reactor (CRBR) Pathfinder powerplant.

Allis-Chalmers and Pioneer Service & Engineering Co. are proceeding with engineering work. Research and development work has been started and will be accelerated during the months ahead.

Studies have shown that a nuclear-fired superheater is feasible for this reactor and plans to develop and use such a superheater of simple design are under consideration.

To augment our existing facilities, we have under construction an engineering laboratory for research and development of nuclear reactors and nuclear powerplant components. We plan to have this laboratory in use before the end of this year.

The construction of this laboratory is further proof of our faith in the future of nuclear power. As a manufacturer of a broad range of equipment for power, both mechanical and electrical, we have particular interest in the uses of nuclear energy for propulsion and for the generation of electric power. In this statement we shall confine our remarks to the latter, except to say, in our opinion, development efforts in the field of ship-propulsion reactors should be applied to more than 1 or 2 types of reactors.

In the field of nuclear power, domestic economic factors alone do not presently provide the necessary profit incentive and driving forces to nourish a vigorous power industry.

There seems to be general agreement that our international prestige and the obligations established by our atoms-for-peace program require that the United States maintain a position of world leadership in the development and use of atomic energy.

That part of the cost of nuclear power, as an instrument of foreign policy, which cannot be supported by domestic economic consideration becomes an obligation which must be met by the expenditure of public funds. Therefore, advancement and the cost of pursuing the objective of economical nuclear power as soon as possible continues to be an obligation of both our industry and our Government.

In recent months, much has been said and written about the necessity for an accelerated nuclear power program and how to achieve it. There seems to be several parallel paths leading to the objective of economical nuclear power. One is the building and operation by electric utilities of nuclear powerplants in their systems, using reactors which have been built and proven, usually in AEC laboratories, at least to the extent of safety and feasibility for economical generation of electric power. We believe the advanced types of boiling-water reactors hold out the best prospects for early economical power.

These plants may be built in the sizes suitable for the chosen locations on their power systems. This appears to be the most effective and quickest way

to get the operating experience necessary for the step-by-step development process which has been so successful in the advancement of the art of power generation.

Another parallel path is the continuation of the Atomic Energy Commission's program of research and development in the more promising types of reactors not yet built and tried in commercial power sizes. These parallel paths also call for the continuation of the Atomic Energy Commission's policy of aiding electric utilities and industry in general, in the research and development necessary for the further advancement of the more promising types of reactors.

In the pursuit of the Atomic Energy Commission's help to industry, a more realistic attitude toward accounting practices and procedures, particularly in the area of what is research and what is capital expenditure, will be most helpful.

Consideration should also be given to modernizing the Atomic Energy Act with reference to patent policy. There should be no limitation on the patenting of inventions by the inventor in the nuclear-power field. Industry should also be able, under Government contracts, to obtain patents, at their own expense, in foreign countries.

It is believed that a realistic reappraisal and easing of the law and regulations, to be consistent with national requirements and present objectives, will do much to encourage industry in an accelerated program for economical nuclear power.

With respect to AEC's controlled thermonuclear program, Allis-Chalmers and the Radio Corporation of America were selected, during the past year, by Princeton University and the Atomic Energy Commission to design, fabricate, install and test a facility at Princeton's James Forrestal Research Center for advanced research into thermonuclear reactions.

The model C-stellerator system is being designed at Princeton by an organization of scientists and engineers from Allis-Chalmers and RCA, known as C-Stellerator Associates. The work of this group is being augmented by the full engineering and manufacturing resources of both companies.

The enthusaistic cooperation of all personnel of Princeton, AEC, and C-Stellerator Associates and the results so far obtained in this project have been most gratifying and encouraging. We feel that the success of this type of relationship will demonstrate beyond doubt that, given the proper challenge and the right atmosphere in which to work, scientists, engineers, and businessmen from Government, universities and colleges, and industry can work together for the common good and advancement of highly scientific endeavor.

Very truly yours,

R. M. CASPER,
General Manager, Nuclear Power Division.

STATEMENT OF KENNETH A. SPENCER, CHAIRMAN OF THE NATIONAL COAL ASSOCIATION, ATOMIC ENERGY COMMITTEE, FEBRUARY 21, 1958

My name is Kenneth A. Spencer. I am president of the Pittsburg & Midway Coal Mining Company of Kansas City, Mo., and chairman of the atomic energy committee of the National Coal Association. It is in this latter capacity that I appear here today. The National Coal Association is the trade organization of bituminous coal mine owners and operators throughout the United States. Its members mine more than two-thirds of the commercially produced bituminous coal in this country.

We in the coal industry are interested in the atomic energy program not only because atomic energy is another esource of fuel but also because the Atomic Energy Commission is one of our best customers. We are concerned, however, over the Gore bill, S. 3000, which appears to be directed toward a crash program in the industrial utilization of atomic energy to generate electricity. Our opposition to this bill is interrelated with existing conditions associated with the present atomic energy program and our views in general as to the development of atomic energy.

With regard to existing conditions, it is our general understanding that the costs of nuclear powerplants as being realized are appreciably higher than estimated, and that nuclear fuel as known is expensive. These conditions are expected to result in nuclear power costs which are far in excess of values competitive with coal-generated power. Because of this, it is understandable that there is no great demand for nuclear power within the United States. This lack

of demand and associated high unit production costs contribute materially toward the maintenance of high nuclear power costs. At the same time there are losses by private industry which is helping to pioneer the development of nuclear power.

It is generally accepted that there is no need here in the United States for nuclear power because of the ample supplies of coal and because of the continued, progressive improvement in efficiency in the generation of coal-derived power. There is some lack of unanimity as to how long it will be before it is necessary to depend upon nuclear power in this country. It is, perhaps, unrealistic to elicit the answer to this question from the coal industry. The data, of course, will depend on the use rate, but very exaggerated use rates would fail to endanger our position for several hundred years. At the same time the most enthusiastic reports that we have reviewed on the development of atomic energy place the coal industry in a healthy position by the year 2000. Therefore, it would appear ill-advised to enter upon an accelerated program of any nature were it possible to consider only the needs of the American power industry.

We understand, however, that there are substantial demands abroad for electricity derived from atomic energy. We understand that this demand exists because of less plentiful supplies of coal and that others, for example the British and the Russians, are in a position to supply these needs. It follows, therefore, that there might be an inroad into the atomic energy facet of the United States prestige were we not in a position to build reactors abroad, and conversely our world position would be enhanced by the continued leadership in the field.

In its resolution adopted November 1, 1955, the National Coal Association stated in part:

"In progression of humanity, in furthering world trade, in advancing the cause of peace, and in maintaining world leadership of the United States, there is a need to continue the Government sponsorship of the development of atomic energy * * *

"Further development of economically feasible nuclear power is necessary to provide power for underdeveloped areas of the world, to assist nations that have power shortages, and to protect the future of the United States in the power field. The National Coal Association therefore recognizes the need for the Government to continue the power demonstration program to optimize the conditions under which atomic power is generated."

Substantial progress has been made in the development of atomic energy since the time this resolution was adopted, and it appears that this progress has been in keeping with it. Aside from the several large reactors being constructed, the Shippingport plant has been placed in operation.

We recognize the possibility that it may be necessary to construct additional reactor types to demonstrate United States leadership. However, we have understood that the Atomic Energy Commission has reviewed the technical aspects of the present systems and has endorsed the several systems now included. We are inclined to agree with this view and see no need to engage in an international kilowatts race.

It is, of course, obvious that lower unit costs on nuclear power systems could be realized with an increase in production rate. However, we disfavor taxing the country as a whole to bring this about, particularly because there is no need for nuclear power in this country, because there is no assurance that such optimized systems would be more economical than coal-fired systems now in use, and because of the apparent high obsolescence of nuclear systems in their present early stage of development.

We should like to suggest that the goals of the Joint Committee on Atomic Energy and those of the National Coal Association as stipulated in its November 1, 1955, resolution on this subject are basically the same. We should like to think that the goals of Senator Gore as outlined in his bill S. 3000, might be included also. However, in pursuit of these goals and in maintaining the expense of the overall program within reasonable bounds, we should like to suggest that the committee give consideration to the following:

1. Encourage the AEC to allow industry to handle more of its business. In this regard we note that when facilities presently under construction are completed there will be some 15,000 tons of uranium oxide processed annually. Apparently this material will find its way into the Commission circles.

We note also that estimates have been made that indicate a minimum of only about 50 tons of uranium will be used in 1958 in the American power industry, and that this will climb to 170 tons by 1961, and to a maximum of 800 tons in

1965. This represents a substantial difference in materials traffic and since one of the reasons advanced for accelerating the civilian program is to reduce costs through a larger handling rate, it would appear that more of the AEC's business might be conducted by industry in developing and maintaining a healthy industrial program. We recognize that this would be only a partial solution at best but we believe substantial assistance to industry would result.

2. Build only adequate large reactors to prove technology. This point is directed, of course, at proving and developing technology rather than stimulating economy through mass production. The mass production idea appears to us to be totally unwarranted because of reasons presented earlier.

3. Compete in the foreign market where United States nuclear power is competitive. It is our understanding that reactors being built now by American industry can be produced on a basis competitive with those provided by the British and we should like to encourage this. We should like to suggest that along with this and, of course, within courses of security, a program of fuel allocation be adopted which would make it as convenient as possible for American industry to do business abroad.

HOUSE OF REPRESENTATIVES,
Washington, D. C., March 13, 1958.

Hon. JAMES E. VAN ZANDT,
House of Representatives, Washington, D. C.

DEAR JIMMIE: I have received a communication from a friend of mine relative to atomic energy development. Undoubtedly, these facts have been called to your attention but in order to stress the situation I am enclosing excerpts below.

He quoted Mr. Roberts' letter to the Atomic Industrial Forum survey which stated:

"If atomic energy was a cheap source of power or if it was closely competitive with present sources, the market for reactors would be increased radically and in a very short space of time.

"The main problem, therefore, facing atomic energy today would seem to be one of finding methods and means of reducing cost of all items connected with it. Because of the low volume of atomic energy business now existing, it would not seem as if industry could be expected to pour large amounts of development money into such cost reduction projects.

"However, the Government in its naval program is affected vitally by such a program and it is our belief that substantial amounts of money should be allotted by Government to industry aimed at cost reduction programs on this premise alone.

"Furthermore, unless some encouragement is given to industry to stay in the business in the future—and many may not stay unless it is going to be profitable to them within a reasonable time—it would seem unfortunate that the technology and personnel which some of them have accumulated should run the risk of being dissipated or disbanded. If this takes place, if war came upon us, this country could be in a dangerous situation.

"We also believe that AEC should operate as regards research and development and production contracts under the same rules and regulations as does the Defense Department. Present methods leave too much latitude to the whims and idiosyncrasies of the contracting officers."

In addition my correspondent states:

"Another problem affecting reactor costs is related to the potential hazards with reactor fuels, without sufficient experience and technology in safe handling and control. This results in considerable caution and the use of large factors of safety in reactor design and fabrication. Experience gained in building and operating reactors, coupled with continuing research and development on reactor fuels, will build up the necessary knowledge to not only improve the fuels themselves but also the problems and costs involved in providing adequate safety. If we are right in this opinion, greater numbers of reactors must be placed in operation even though not justifiable economically at the present time. These reactors must be for both civilian and military use, as the experience and requirements with strictly military applications with their special requirements will not build an adequate technological base for increasing civilian use.

"We are, as you know, in complete agreement with the conclusion that fixed-price contracts for research and development work are unworkable and undesirable when exploring a new field with little past experience for guidance."

Sincerely,

WILLIAM H. BATES,
Member of Congress.

COMBUSTION ENGINEERING, INC.,
New York, N. Y., March 21, 1958.

Hon. CARL T. DURHAM,
Chairman, Joint Committee on Atomic Energy,
Congress, Washington, D. C.

DEAR MR. DURHAM: Enclosed is a statement that Combustion Engineering, Inc., would like to have incorporated in the record of the 202 hearings being held by the Joint Committee.

Our company has never before appeared or submitted a statement during these hearings. We are submitting this statement for the record, and we are not asking to be permitted to appear.

Thank you for offering us this opportunity.

Sincerely yours,

JOSEPH V. SANTRY, *Chairman.*

STATEMENT OF COMBUSTION ENGINEERING, INC.

Combustion Engineering, Inc., is 1 of the 2 largest manufacturers of steam generating equipment in the world. We supply a large fraction of the boilers used by our country's utility industry, and through subsidiaries and licensees we also do extensive business abroad.

We hope and expect that we will occupy the same major role in the atomic power industry that we have played in the field of conventional steam generating equipment.

Combustion is a modest-sized company, with total assets approximating $100 million. Nonetheless, we have already invested more than $30 million in atomic energy activities.

Of this sum, $22 million has been invested in nuclear facilities at Windsor, Conn., and Chattanooga, Tenn. We contributed $1 million to the PRDC Detroit Edison group. We have also absorbed research and development costs totaling more than $6 million in the manufacture of nuclear components.

Finally, we contributed $3 million of our money toward the research and development costs of the powerplant for the hunter-killer submarine.

We sincerely believe that, particularly in view of our company's limited assets, the size of our investment in atomic power development is unique.

CE NUCLEAR FACILITIES

Completely with its own money, Combustion has built a $16 million nuclear engineering and development center at Windsor, Conn., on a site covering 535 acres. To the best of our knowledge, this is the largest privately owned facility of its kind in the world.

The Windsor laboratory includes a core manufacturing and assembly plant, a materials development laboratory, an engineering development laboratory, two buildings containing critical experiments, and a large engineering and administration building.

Over 1,000 people, including more than 300 scientists and engineers, are now employed at Windsor.

At its Chattanooga plant, Combustion has the country's first facility specifically built for the design and manufacture of heavy nuclear components. Our $6 million nuclear power building contains machinery and ventilation equipment designed for the sole purpose of providing the extreme tolerances and absolute integrity required of nuclear components.

There are over 500 people employed in the nuclear components group at Chattanooga, of whom over 100 are engineers and scientists.

CE NUCLEAR ACTIVITIES

Complete nuclear powerplant systems

CE is designing, developing, and building for the Atomic Energy Commission a land-based prototype of a nuclear powerplant for a hunter-killer submarine. Construction of the prototype at our Windsor laboratory started in August 1956. CE also has a contract with the United States Navy to provide the design and engineering necessary to furnish reactor components to the nuclear-propelled submarine *SS (N) 597*.

Nuclear components

CE has been a major supplier of powerplant components for our nuclear Navy. Components for these powerplants of our atomic fleet have been or are being built by CE. Included in these components are pressure vessels steam generators, and pressurizers.

The pressure vessel of the world's first full-scale civilian powerplant, the Shippingport reactor, was built in the shops of CE. In addition, we are now manufacturing the pressure vessel for the Detroit Edison Enrico Fermi fast breeder reactor, and we will ship it shortly.

Nuclear cores

CE now has contracts for five nuclear submarine cores, with our first core scheduled for delivery to the United States Navy during the coming month.

Other atomic work

One subsidiary of CE is the Lummus Co., which has engaged in the design and engineering of major portions of the heavy-water projects at both Dania and Savannah River. The Lummus Co. has also completed the design and engineering work on a nitric acid recovery system at the Hanford, Wash., installation of the Atomic Energy Commission.

THE AREA OF TECHNICAL DECISION

When compared to conventional plants, atomic powerplants today exhibit both high capital costs and high fuel costs.

Cost reduction through component elimination and simplification is, of course, important. Yet we believe that the real area of greatest challenge, and greatest potential improvement, lies in the very heart of a reactor system—its nuclear fuel. For water reactors, this means cores with cheaper fabrication and reprocessing costs and, above all, longer lives. This goal, in turn, is dependent upon a far more intimate knowledge of reactor physics and reactor materials than we possess today.

It is of critical importance that the Atomic Energy Commission support research and development progress in these areas at the highest possible level—in its own laboratories, in the universities, and among industrial contractors. We particularly hope that greater support will be forthcoming for applied research and development projects in industrial laboratories.

Designers of nuclear powerplants are today in the same position confronting airplane designers in the early years after Kitty Hawk. Known technology has been pressed to the limit. No standard body of reactor theory now exists. Trial and error must often substitute for scientific prediction.

Even in today's most advanced reactor system, light pressurized water, the range of technological uncertainty is enormous. The area of the unknown is progressively greater in systems possessing more sophisticated technologies.

Even modest advances in reactor design involve major research and development progress. Often, the cost and duration of such efforts cannot be predicted in advance.

Side by side with this, we have only begun to amass operating experience with central power reactors. Until many such plants are designed, built, and operated, it will be difficult, if not impossible, to identify accurately the reactor types having the greatest long-term promise for competitive power.

During the foreseeable future, a vigorous atomic power development program will continue to require the support of both Government and industry. Neither can do the job alone.

COMBUSTION'S PHILOSOPHY OF ATOMIC DEVELOPMENT

Our guiding principles throughout have been these: The road to useful atomic power will be long, difficult, and costly. We must learn to walk before we can run.

From the very beginning, we warned potential reactor customers not to underestimate costs and technical difficulties. From the very outset also, we detemined not to undertake projects to which our technical competence was not yet equal.

When in late 1955 we began designing our first complete nuclear powerplant for the hunter-killer submarine, it was required that the company take on no other reactor design jobs.

As a result of heretofore concentrating all our energies on this one task, we are meeting the severe schedule and rigorous technical specifications of the hunter-killer submarine.

Over the past 2 years, however, our competence has steadily grown. We have received invaluable counsel and technical assistance from the Atomic Energy Commission and especially from Adm. H. G. Rickover and his associates in the Naval Reactors Branch. Further, we have ourselves sponsored an ambitious training program for the CE technical staff.

We have now satisfied ourselves that we can take on additional major reactor projects without jeopardizing our existing programs.

It has been a great privilege for us to be associated with the cause of harnessing the atom for useful power.

(Whereupon, at 3:35 p. m., Tuesday, March 4, 1958, the hearing adjourned.)

STATEMENTS OF UNITED STATES ATOMIC ENERGY COMMISSION TO THE CONGRESSIONAL JOINT COMMITTEE ON ATOMIC ENERGY CONCLUDING COMMISSION PRESENTATIONS [1]

A. Summary of Status of Power Reactor Program in Early 1958

It has now been 3½ years since amendment to the Atomic Energy Act and the relaxation of the Government's monopoly in the field of atomic energy. In that time there has been wide progress in power-reactor development. We are not yet at the point of economically competitive nuclear power reactors, except possibly in certain unusually high power cost areas. We have advanced power reactor technology markedly.

At present there are a number of power reactors and power-reactor experiments operating or under construction in the United States. Six experimental power reactors were completed in 1957. Three of these have produced electricity for distribution over existing utility systems—the Shippingport plant, the sodium-reactor experiment, and the Vallecitos plant. The other three are the homogeneous reactor experiment No. 2 at Oak Ridge National Laboratory, organic moderated reactor experiment at the National Reactor Testing Station, and the Army package power reactor No. 1 at Fort Belvoir, Va.

Among those reactors under construction are four commercial plants which are all large scale. These are the Commonwealth Edison plant in Illinois, the Consolidated Edison plant in New York State, the Enrico Fermi plant in Michigan, and the Yankee atomic electric plant in Massachusetts.

The Vallecitos boiling water reactor was dedicated near Pleasanton, Calif., on November 25, 1957, by the General Electric and the Pacific Gas & Electric Cos. This plant is generating electricity for distribution over the Pacific Gas & Electric system.

As the power-reactor program is midway of its fourth year, one can see how extensive is the growth in technology.

To begin with, the record shows that we have largely carried out the original program formulated by the AEC and supported by your committee in early 1954. This undertaking, variously called the 5-year or the 5-reactor program, envisioned the development, design, construction, and operation of 5 reactors, each of a different type. Four of these were to be small-scale reactor experiments. They are the experimental boiling water reactor (EBWR), the sodium reactor experiment (SRE), the experimental breeder reactor No. 2 (EBR–2), and the homogeneous reactor experiment No. 2 (HRE–2). The fifth project was for an experimental prototype pressurized water reactor, the Shippingport atomic powerplant.

It is a source of satisfaction to us that, by the end of 1957, 4 of these 5 reactors had gone critical. This means that a large amount of research and development has already been accomplished successfully, that we have accumulated considerable experience in design and construction, and that we are now in a position to derive benefits from experimental operation of these reactors.

The only one of the original reactors which remains to be completed is the EBR–2. Construction of this plant is underway and it is now hoped it will be completed and in operation by 1960.

In reviewing specific advances during the past year, attention quickly becomes focused on one day, December 2. Two of the most significant events of the year occurred on that day, which, incidentally, marked the 15th anniversary of the achievement of the first nuclear chain reaction. One of these was the first criticality of the reactor at the Shippingport atomic power station. The other was the achievement by the experimental boiling-water reactor of a thermal output more than twice its designed rating.

The significance of the Shippingport accomplishment needs little comment. It is our first large-scale nuclear powerplant. At its designed rating of 60,000 electrical kilowatts net, which was first achieved on December 23, it produces more electricity than any other individual reactor in the world. Notwithstanding its size, the Shippingport reactor is experimental in purpose. The important thing about it is not the cost of the power it produces, which we have

[1] The additional statements were subsequently received from the AEC to complete its testimony during the 1958 section 202 hearings.

known from the first would be high, but the fact that it exists and that from it we can learn important things about design, construction, and operation of full-scale nuclear powerplants. It is an impressive achievement.

The EBWR's demonstration of stable operation at more than double its design power rating has significance from more than one point of view. To begin with, it is encouraging as a demonstration of capability to produce power at a lower capital cost per unit of capital investment.

EBWR's success is also vindication of the philosophy which underlay the 5-year program, the concept, namely, that through experimental operation of small and relatively inexpensive plants we can make substantial advances toward economic nuclear power.

Another event of 1957 which deserves comment for its wider implications was the first criticality of the organic moderated reactor experiment (OMRE) at Idaho. This was a concept which was not included in the original program and points up the fact that in a young technology new ideas and concepts constantly emerge.

We have sought to develop the best of these ideas as rapidly as possible. In the case of the OMRE, for example, if radiation damage to the organic coolant proves not to be excessive, we have an additional reactor concept which can be exploited in full-scale plants with minimum developmental work. Experience of early 1958 with this reactor is encouraging.

In following the progress of reactor-development programs, there may be a tendency to give exclusive attention to the initiation or operation of reactor projects. Notwithstanding the very great importance of such events, one should emphasize the various supply and service functions essential for support of a reactor industry—work on fuel materials, fuel fabrication, fuel processing, utilization of fission products and radiation of byproducts, waste disposal, operation of radiation test facilities, and the like. Some of the larger problems between us and attainment of economic nuclear power lie in these areas.

Encouraging progress was made last year by both Government and industry in the development of oxide and other ceramic fuel elements. These types offer promise of having greater stability and longer life than metallic fuel elements. For example, radiation stability at exposures in excess of 10,000 megawatt-days per ton has been demonstrated in samples of some of these fuel materials. Moreover, new fabrication techniques with promise of lower unit costs for oxide elements have also been developed and demonstrated on a modest scale.

These are accomplishments whose tendency is to bring down the fuel component of nuclear-power costs. For substantial reductions to be achieved, however, there must be expanded work on these and other new types of fuel elements and other aspects of the fuel cycle must also be given increased attention.

Details of the progress in the Nation's development of power reactors are fully reported in the 23d semiannual report, pages 77–136, which has been filed with you as the Commission's general written testimony.

The progress to date in the privately financed, Government-financed, and cooperative programs is heartening. All of us desire to maintain it. However, as with any area of human endeavor, conditions change in the atomic energy field, and as progress is achieved we find that new problems emerge. We are now in the midst of a thorough review of the civilian power-reactor program to determine whether modifications are necessary. This program is extremely complex and many factors must be studied carefully in the course of such a review.

Both the Joint Committee and the Commission have held extensive discussions in this area with leaders from the major segments of the atomic industry. We received from the committee on November 27, 1957, a letter suggesting that it would be in the national interest for the Joint Committee and the Commission to cooperate in clarifying our program objectives. This letter led to a series of informal sessions in which both members of your committee and members of the Commision, as well as our respective staffs, have examined the current problems and considered possible courses of actions which might broaden plans for the future.

A truly cooperative effort is proceeding with the purpose of reaching workable solutions to the many future problems which face the industry and ourselves. All concerned are taking part. These hearings under section 202 of the act have been an important phase of the necessary exchange of ideas that precedes decision and action, and we are glad to play our part in them.

The process now underway will add new elements to our atomic energy program under which this Nation will continue to advance toward the basic goal

of placing power from atomic energy at the service of mankind and spreading the area in which atomic power can be competitive until it covers the whole world.

B. Information Updating Cost and Schedule Estimates on Civilian Reactors Submitted Originally and in Calendar Year 1957 for Section 202 Hearings

The costs shown include cost of plant construction and the costs associated with the fabrication or preparation of fuel elements (when this data is available). The cost of the related research and development program and operating costs are not included.

The original and February 1957 estimated cost and schedule for low-power operation are as given in the calendar year 1957 section 202 hearings. The current estimates represent the most recent data available.

5-year program

Pressurized water reactor (PWR), Shippingport, Pa.: Original estimate of initial low-power operations, July 1957; February 1957 estimate of initial low-power operations, December 1957:

Initial low-power operation, December 1957:

	Thousands
Original estimated cost:	
Reactor plant	$37,750
Turbine generator	10,000
Total	47,750
February 1957 estimated cost:	
Reactor plant	[1] 55,000
Turbine generator	15,000
Total	70,000
Actual cost:	
Reactor plant	[1] 55,000
Turbine generator	17,500
Total	72,500

Boiling water reactor (BWR), Argonne National Laboratory: Original estimate of initial low-power operation, December 1956; February 1957 estimate of initial low-power operation, December 1956:

Initial low-power operation, December 1956:

	Thousands
Original estimated cost:	
Reactor fabrication	$2,600
Fuel fabrication	900
Building and supporting facilities	1,000
Total	4,500
February 1957 estimated cost:	
Reactor fabrication	3,945
Fuel fabrication	1,195
Building and supporting facilities	1,000
Total	6,140
Actual cost:	
Reactor fabrication	3,636
Fuel fabrication	1,263
Building and supporting facilities	992
Total	[2] 5,891

[1] Includes a $5 million investment by Duquesne Power & Light Co. in the project and a $0.5 million contribution by Westinghouse Electric Co. Includes cost of the initial core, buildings, and supporting facilities. The February 1957 estimate included $13 million for the initial core; the current estimate includes $12.4 million for initial core.

[2] Represents final cost data.

5-year program—Continued

Homogeneous reactors (HRE No. 2), Oak Ridge National Laboratory: Original estimate of initial low-power operations, June 1956; February 1957 estimate of initial low-power operations, December 1957:
Initial low-power operations, December 1957:

	Thousands
Original estimated cost:	
Reactor fabrication	$1,800
Fuel preparation	[3]
Reactor fabrication	$1,800
Fuel preparation	[3]
Building and supporting facilities	630
Total	2,430
February 1957 estimated cost:	
Reactor fabrication	[4] 3,000
Fuel preparation	[3]
Building and supporting facilities	[5] 630
Total	3,630
Actual cost:	
Reactor fabrication	[4] 3,008
Fuel preparation	[3]
Building and supporting facilities	[5] 631
Total	3,639

Sodium graphite reactor (SRE), Santa Susana, Calif.: Original estimate of initial low-power operations, June 1956; February 1957 estimate of initial low-power operations, June 1957:
Initial low-power operations, April 1957:

	Thousands
Original estimated cost:	
Reactor fabrication	$3,500
Fuel fabrication	220
Building and supporting facilities	[6]
Total	3,720
February 1957 estimated cost:	
Reactor fabrication	6,800
Fuel fabrication	230
Building and supporting facilities	[6]
Total	[7] 7,030
Actual cost:	
Reactor fabrication	7,281
Fuel-element fabrication	327
Buildings and supporting facilities	[6]
Total	[7] 7,608

[3] Costs of preparing uranyl sulfate are not significant.
[4] Includes chemical fuel reprocessing facilities.
[5] Includes cost of building originally constructed to accommodate HRE No. 1 as well as cost of alterations necessary for HRE No. 2.
[6] Cost of construction of buildings and supporting facilities financed by NAA was estimated in February 1957 at $0.92 million. The current estimate is $0.93 million. The building amortization is included in the overall cost of the project. The overall cost of the project through fiscal year 1957, including "research and development," is $16.7 million. Of this amount NAA shared $2.85 million of such overall costs.
[7] Does not include costs of power-generating equipment installed by Southern California Edison Co. The February 1957 estimate was $1.1 million. Actual cost was $1.4 million.

5-year program—Continued

Experimental breeder reactor No. II (EBR–II), Argonne National Laboratory: Original estimate of initial low-power operations, March 1958; February 1957 estimate of initial low-power operations, June 1959:

Current estimate of initial low-power operations, July 1960:

Original estimated cost:	*Thousands*
Reactor fabrication	$12,000
Fuel fabrication	1,400
Processing plant	2,050
Total	15,450
February 1957 estimated cost	29,100
Current estimated cost:	
Reactor and power cycle	18,048
Fuel fabrication	([8])
Processing plant	7,920
Sites 16 NTS	3,132
Total	29,100

Organic moderated reactor experiment (OMRE), national reactor test station initial low-power operation, September 1957:

Current estimated cost:	*Thousands*
Reactor fabrication	$2,030
Fuel fabrication	242
Building and supporting facilities	342
Total	2,614

[8] Preliminary estimate for fuel is $1,893,000. (This cost is not to be included in the capital cost of the plant.)

Power Demonstration Reactor Program

FIRST ROUND

Consumers Public Power District (SGR), Beatrice, Nebr.: Original estimate of initial low-power operations, 1959; February 1957 estimate of initial low-power operations, 1962:

Current estimate of initial low-power operations, 1962:

Original estimated cost:	*Thousands*
Reactor	$13,129
Fuel fabrication	631
Land, buildings, and suporting facilities	2,649
Electrical generating facilities	8,701
Total	25,110
February 1957 estimated cost:	
Reactor	26,630
Fuel fabrication	631
Land, buildings, and suporting facilities	2,649
Electrical generating facilities	8,701
Total	38,611

Power Demonstration Reactor Program—Continued

Current estimate of initial low-power operations, 1962—Continued

Current estimated cost:	Thousands
Reactor	$29,233
Fuel fabrication	[1]
Land, buildings, and supporting facilities	[2] 12,692
Electrical generating facilities	8,250
Total	[3] 50,175

Yankee Atomic Electric Co. (PWR), Rowe, Mass.: Original estimate of initial low-power operations, 1958; February 1957 estimate of initial low-power operations, 1960:

Current estimate of initial low-power operation, 1960:	
Original estimated cost:	Thousands
Reactor	$16,765
Fuel fabrication	[4]
Land, buildings, and supporting facilities	2,275
Electric generating facilities	13,880
Total	32,920
February 1957 estimated cost:	
Reactor	16,765
Fuel fabrication	2,000
Land, buildings, and supporting facilities	5,210
Electric generating facilities	10,525
Total	34,500
Current estimated cost:	
Reactor	38,413
Fuel fabrication	3,600
Land, buildings, and supporting facilities	4,084
Electric generating facilities	11,420
Total	[4] 57,517

Power Reactor Development Co. (FBR), Monroe, Mich.: Original estimate of initial low-power operations, 1960; February 1957 estimate of initial low-power operations, 1960:

Current estimate of initial low-power operations, 1960:	
Original estimated cost:	Thousands
Nuclear facilities	$34,300
Fuel element fabrication	3,500
Nonnuclear facilities	10,700
Total	48,500
February 1957 estimated cost:	
Nuclear facilities	31,225
Fuel element fabrication	2,100
Nonnuclear facilities	14,000
Total	47,325

[1] No current estimate available as core design is undergoing change.
[2] Major cause of increase is for conventional boiler provided by Consumers.
[3] Consumers investment in the total project cost amounts to $26.2 million, which includes conventional boiler, electrical-generating facilities, land, buildings, and supporting facilities, and $5.2 million investment in the reactor plant.
The current estimate for reactor cost is the same as that authorized by Congress in the fiscal year 1958 authorization under section 261 of the act. Other increase in the total plant cost occurred in the conventioned portion of the plant which is being borne by Consumers.
[4] Cost of construction borne by Yankee Atomic Electric with no AEC investment in construction.

Power Demonstration Reactor Program—Continued

Current estimate of initial low-power operations, 1960—Continued

Current estimated cost:	*Thousands*
Nuclear facilities	[5] $37,020
Fuel element fabrication	([6])
Nonnuclear facilities	14,061
Total	51,081

[5] This does not include PRDC allowance of $1,175,000 for working capital, or any allowance for research and development expenses, plant operating costs, or waiver of fuel use charge.
[6] Included in nuclear facilities.

SECOND ROUND

Wolverine Electric Cooperative (homogeneous reactor), Hershey, Mich.: Original estimate of initial low-power operations, 1960; February 1957 estimate of initial low-power operations, 1961:

Current estimate of initial low-power operations, not available:

Original estimated cost:	*Thousands*
Reactor	$2,835
Fuel fabrication	-------
Land, buildings, and supporting facilities	-------
Electrical generating facilities	739
Total	3,574

February 1957 estimated cost:	
Reactor	3,787
Fuel fabrication	([1])
Land, buildings, and supporting facilities	([2])
Electrical generating facilities	757
Total	4,544

Current estimated cost:	
Reactor	10,348
Fuel fabrication	([1])
Land, buildings, and supporting facilities	([2])
Electrical generating facilities	1,810
Total	[3] 12,158

Rural Cooperative Power Association (BWR), Elk River, Minn.: Original estimate of initial low-power operations, 1959; February 1957 estimate of initial low-power operations, 1961:

Current estimate of initial low-power operations, 1960:

Original estimated cost:	*Thousands*
Reactor	$3,760
Fuel fabrication	-------
Land, buildings and supporting facilities	700
Electrical generating facility	1,725
Total	6,185

February 1957 estimated cost:	
Reactor	5,545
Fuel fabrication	-------
Land, buildings and supporting facilities	700
Electric generating facilities	1,750
Total	7,995

[1] Fuel preparation costs for homogeneous reactors are not significant.
[2] Facilities to be located in existing structure.
[3] The JCAE was notified on Aug. 23, 1957, that Foster Wheeler was no longer willing to undertake the project on a ceiling price basis. The company estimated the total plant cost at $14,386,000 under a cost type contract. The estimate of $12,158,000 was made by the ORO and represents the AEC estimate of cost to carry out the objectives of the Wolverine proposal still under consideration by the Commission.

Power Demonstration Reactor Program—Continued

Current estimate of initial low-power operations, 1960—Continued

Current estimated cost:	Thousands
Reactor	$8,990
Fuel fabrication	-------
Land, buildings and supporting facilities	700
Electrical generating facilities	1,750
Total	11,440

Chugach Electric Association (SGR), Anchorage, Alaska: Original estimate of initial low-power operations, 1961:

Current estimate of initial low-power operations, 1962:

Original estimated cost:	Thousands
Reactor	$5,500
Fuel fabrication	[4]
Land, buildings and supporting facilities	-------
Electrical generating facilities	[5] 1,850
Total	7,350
Current estimated cost:	
Reactor	9,229
Fuel fabrication	[4]
Land, buiidings and supporting facilities	-------
Electrical generating facilities	[5] 1,850
Total	[6] 11,079

City of Piqua, (OMR), Piqua, Ohio: Original estimate of initial low-power operations, 1961:

Current estimate of initial low-power operations, 1961:

Original estimated cost:	Thousands
Reactor	$4,010
Fuel fabrication	-------
Land, buildings and supporting facilities	580
Electrical generating facilities	1,031
Total	5,621
Current estimated cost:	
Reactor	4,677
Fuel fabrication	[7]
Land, buildings and supporting facilities	[8] 1,780
Electrical generating facilities	2,175
Total	[9] 8,632

[4] Not available
[5] Includes site and necessary structures.
[6] A revised estimate was not available as of February 1957. The JCAE was furnished the revised estimate of $6,729,000 for the fiscal year 1958 authorization under sec. 261. Since the August 1957 estimate $2,500,000 has been added as an estimate for reactor-containment, additional instrumentation, and escalation.
[7] Fuel for 5 years' operation to be supplied under contract for $1,746,000.
[8] Includes standby steam generator.
[9] A revised estimate was not available as of February 1957. The JCAE was furnished the estimate of $4,010,000 for the cost of the reactor for the fiscal year 1958 authorization under sec. 261. Since that time, the cost estimate has been revised to $4,677,000.

THIRD ROUND

Northern States Power Co., Sioux Falls, S. Dak.:

Current estimate of initial low-power operation, June 1962:

Current estimated cost:	Thousands
Reactor	[1] $12,190
Fuel fabrication	[2]
Land, buildings, and supporting facilities	3,560
Electrical generating facilities	5,850
Total	21,600

[1] Includes superheater.
[2] Not available.

Power Demonstration Reactor Program—Continued

PRIVATELY FINANCED LICENSED PROGRAM

Consolidated Edison Company of New York (PWR), Indian Point, N. Y.:
Original estimated completion date: 1960.
February 1957 estimated completion date: 1960.
Current estimated completion date: 1960.
Original estimated cost: $55,000,000.
February 1957 estimated construction cost: $70,000,000.
Current estimated construction cost: $90,000,000.[1]

Commonwealth Edison Co. (BWR), Dresden, Ill.:
Original estimated completion date: 1960.
February 1957 estimated completion date: 1960.
Current estimated completion date: 1959.
Original estimated contract price: $45,000,000.
February 1957 estimated contract price: $45,000,000.[2]
Current estimated contract price: $45,000,000.[2]

General Electric Co. (BWR), (boiling-water reactor), Vallecitos, Calif.:
Original estimated completion date: 1957.
February 1957 estimated completion date: 1957.
Completion date: August 1957.
Original estimated construction cost: $3,000,000 to $4,000,000.[3]
February 1957 estimated construction cost: $3,000,000 to $4,000,000.[3]
Current estimated construction cost: $2,500,000.[3]

[1] Includes research and development.
[2] Relationship between contract price and cost of construction is not known.
[3] Reactor fabrication only.

C. Statement of United States Atomic Energy Commission to the Joint Congressional Committee on Atomic Energy Concerning Civilian Power-Reactor Program Contracting Policies

The policies and practices followed by AEC in contracting for research and development in the civilian power reactor field are essentially the same as those which apply to the military reactor, production, weapons, or any other of its programs. That portion of the civilian-power reactor program which involves cooperative arrangements under the power demonstration reactor program may be considered an exception since such cooperative arrangements are themselves exceptional. Some of these were discussed with the committee last spring during the hearings on authorizing legislation. Before getting into these subjects again, however, the broader base of similarity should be described.

The most important consideration in obtaining economical and efficient performance of work under a cost-type contract—and this applies also whether it is the civilian power program or any other AEC program—is the selection of the contractor best qualified to perform the work, considering all applicable factors. The abilities of the technical and supervisory personnel, and adequacy of facilities, the effectiveness with which resources may be brought to bear upon scientific and technical problems which require solutions, and the general approach to economy and costs of operations are the most important considerations affecting selection. Where such factors do not dictate the choice of contractors, it is recognized in the selection of prime contractors that it is advantageous to develop a larger reserve of experienced contractors. Usually a board of senior staff members with complementary talents investigates these various facets in the context of the specific requirements for the particular job and makes a recommendation.

The terms embodied in all contracts of the AEC usually describe the scope of the work to be done in broad terms and place considerable emphasis upon providing a means for the development of annual work programs, and upon furnishing to AEC reports and information on results and accomplishments. Such contracts are not routine arrangements for the procurement of objects or services which can be defined in detail. Rather they are working agreements between 2 parties in which 1 party (AEC) reserves to itself the right to direct the course of the work and agrees to pay for it while the other party (the contractor) agrees to do the best job possible of pursuing the prescribed course of work in an effective and businesslike manner.

The approach to contractual clauses on administrative and financial matters is basically the same whether the work is part of the civilian-power program, the military reactor program, the production or weapons program. Under a cost-type contract, for example, provision is made for reimbursement of the cost of the work, employment of the staff required to perform it, and a fee for management services rendered. Indemnity for special hazards directly associated with the work is also provided.

Under cost-reimbursement contracts, the Commission's policy is to reimburse its contractors for all direct costs necessary or incident to the performance of the contract and the properly allocable portion of indirect costs, exclusive of certain types of costs that are specifically set forth as unallowable. Examples of the costs which are unallowable are bad-debt losses, dividend provisions or payments, entertainment, contributions and donations, Federal income taxes, losses on other contracts, and selling expenses not applicable to the contract product or services.

The basic AEC policy on the payment of fees under cost-plus-a-fixed-fee contracts provides that "fees negotiated on cost-plus-fixed-fee contracts shall be based upon the scope and character of the work to be performed by the contractor, shall be fair and reasonable, and shall not exceed amounts prescribed by law or direction of the General Manager."

AEC administrative limitations on fixed fees have been established for construction and related engineering contracts and for supply contracts. The maximum fees for the former are established by an official fee curve and the latter normally by a limitation of 7 percent of estimated cost of the contract exclusive of the fixed fee.

With respect to cost-plus-a-fixed-fee contracts, the lowest fees percentagewise are generally paid for the operation of an AEC-owned facility where—

(*a*) The work is performed at one location;

(*b*) Working capital is provided by the Government;

(*c*) All plant and equipment and materials required at the site are provided by the Government;

(*d*) There is a good probability of continued operation of the facilities; and

(*e*) Most normal business risks, including nuclear hazards, are assumed by the Government.

Higher fees are paid for research and development operations where the contractor has less assurance of a continuing long-term program and management effort required is greater per dollar expended in that a higher average level of technical competency in employees is required and there is a minimum of repetitive routine operations.

The highest fees percentagewise are paid where the work is being performed in contractor-owned facilities, by the contractor's regular organization, and with working capital provided by the contractor.

Where the contract is performed in contractor-owned facilities, home-office expenses are reimbursed to the extent that they benefit and are allocable to the work. Generally, where the work under a contract is performed in Government-owned facilities, and the services normally provided by the contractor's home office are performed at the operation site, no additional reimbursement is made for general home-office expenses.

The Commission's policy of contracting on a fixed-price basis whenever feasible also extends to the reactor-development field. On large-scale research and development projects the cost-plus-a-fixed-fee contract, rather than a lump-sum or fixed-price contract, is used because it is not possible to estimate accurately in advance, the probable cost of the work, or the scope thereof to the extent necessary to obtain bids or to negotiate on a fixed-price basis. Under such conditions if a lump-sum or fixed-price contract were sought, a contractor would have to reduce his risks to some extent by including in his price contingencies of a magnitude which could easily make the price unacceptable to AEC. However, even on cost-type contracts, substantial portions of the work are being accomplished through fixed-price subcontracts for particular segments of work. Moreover, as described on pages 153–158 of the Commission's 23d semiannual report, substantial progress is being made in obtaining reactor components, special reactor materials, and certain services on a commercial basis.

It is our aim to avoid wherever possible the expenditure of Government funds for additional capital facilities and equipment needed for both the military and civilian power-reactor-development programs. This aim is different from that in the case of many types of production and weapons facilities where commercial

applications are remote and, it is considered good policy to retain such facilities under direct government control. In the reactor-development field, however, a major aim is to encourage those companies that are interested in preparing themselves to engage in reactor work on a commercial basis. One way of doing this is to get AEC work performed in private facilities that also can be used for commercial work by the owner. Because of necessary restrictions on use of AEC facilities, our experience indicates a substantial number of companies would prefer to perform AEC development work in their own facilities for just that reason.

As stated earlier the only significant difference between contract policies for the AEC's civilian power program and those applicable to other programs is in connection with the power demonstration reactor program. For this program the Commission has established certain general criteria which are in addition to those normal contract policies described above. These additional criteria are stated in the public invitations issued for the three rounds of the power demonstration reactor program. They stem from a basic difference in responsibility: the other programs are AEC programs and AEC retains full direction and control; under the civilian power demonstration program, the bulk of the work remains that of the proposer and he retains control. The AEC is in a position of assisting the proposer of the project, for mutually advantageous purposes, in accomplishing a program, rather than financing and directing a project which is 100 percent its own work. It retains control to the extent of assuring that the funds it provides are effectively utilized on that segment of the project which constitutes the basis for AEC assistance.

In preparing a program of assistance within this context, the Commission had two basic principles in mind: to retain all the basic cost incentives of private industry while providing some measure of assistance. This is achieved by what we call the "closed end" principle. Under this concept the Commission may extend various forms of assistance. But, once these have been agreed to, the maximum dollar amount of assistance to be provided by the Commission is fixed. The proposers have the full technical and economic responsibility. If the project costs more than planned, the Commission is not committed to fund the increase. Conversely, if the total job can be done for less, the Commission pays only the actual cost. This is quite different from the cost-plus-fixed-fee method of doing development work usually used by the Commission.

In accordance with provisions of the 1957 Authorization Act the Commission has departed from the closed-end principle in its contract with Consumers Public Power District of Nebraska and will also in contracting for operation of the four reactors in the second round of the power demonstration reactor program.

Although each power-demonstration project involves special problems which preclude the use of standard-form contracts, the AEC makes every reasonable effort to negotiate contract terms which are consistent and equitable.

D. Correspondence Concerning Commission Comments on Views of Industry

---

Joint Committee on Atomic Energy
Congress of the United States

March 5, 1958.

Mr. K. E. Fields,
General Manager, United States Atomic Energy Commission
Washington, D. C.

Dear Mr. Fields: This will confirm the scheduling of the Commission's "202" testimony on the atomic-power program, and contract policy in relation thereto, for Wednesday and Thursday, March 12 and 13, at 10 a. m. and 2 p. m., each day until completion.

In connection with the discussion by the Commissioners and AEC representatives it would be appreciated if they would be prepared to furnish comments on the following matters:

1. The recent surveys on the views of industry on the status and prospects of the domestic and foreign atomic power programs conducted by the Atomic Industrial Forum and Nucleonics magazine.

2. The summary of the findings of the informal seminars with reactor experts and industry representatives held by the Joint Committee on November 21 and 22, 1957, as contained in JCAE release No. 121 dated February 3, 1958.

In addition we would like to be brought up to date on the details of the status of the declassification and the making available of military and civilian reactor information. As you will recall the AEC provided considerable testimony on this problem at our hearings last year.

Very truly yours,

CARL T. DURHAM, *Chairman.*

UNITED STATES ATOMIC ENERGY COMMISSION,
Washington, D. C., April 4, 1958.

Hon. CARL T. DURHAM,
Chairman, Joint Committee on Atomic Energy,
Congress of the United States, Washington, D. C.

DEAR MR. DURHAM: By letter of March 5, you requested Commission comments concerning the views of industry on industrial nuclear development as expressed in the Atomic Industrial Forum and Nucleonics surveys and the committee's seminars with reactor experts and industry representatives. These views relate to many aspects of the United States civilian nuclear power program, covering such subjects as required level of Government financial support, possible subsidies, distribution of increased research and development assistance, and the technological approach best designed to achieve our long-range goal of economic nuclear electric power in the United States.

As you know, there has been a series of informal sessions in which members of your committee and members of the Commission have reached preliminary agreement on general objectives concerning civilian atomic-power development. These views of industry, together with many additional views expressed on other occasions, have been very useful to us in our present detailed review of the power program. However, although the development of our plans are well along, they are not yet fully developed.

After reviewing the suggestions in the surveys and seminars mentioned in your letter we have reached the conclusion that we can only provide you with a complete and fully satisfactory answer to these and other comments relating to development of civilian power by completion of the proposed power program. The full development of that program should answer most of the major questions which have been raised by industry. To the extent that you believe it does not, we will be glad to provide you with comments on any of the specific questions you feel remain unresolved. We hope you will agree that this approach is advisable.

Several of the comments from industry concerned AEC contracting practices. On March 12 we forwarded to you a statement concerning the policies and practices followed by AEC in contracting for research and development in the civilian power reactor field.

Based upon surveys sponsored by the Commission covering the technical manpower needs of the Commission, its contractors, and of private industrial atomic-energy activities, the Commission has reached conclusions concerning the manpower situation similar to those expressed in your seminars. Although some shortages exist in certain fields such as metallurgy and ceramic engineering, no general shortage of scientists and engineers has hampered atomic-energy programs. Our surveys have indicated a substantial increase in future requirements for some kinds of specialists, however, and the Commission will continue with its efforts to help educational institutions meet the future requirements for scientists and engineers in atomic energy activities. Results of the surveys were forwarded to you on October 4, 1957, and March 12, 1958.

You also asked to be brought up to date on the status of declassification and the making available of military and civilian reactor information.

Under the terms of the declassification guide which was put into effect on December 5, 1957, the Commission authorized the declassification of all reactor information which was not primarily applicable to military reactors or to production reactors. As a result all reports concerning the design, construction or operation of civilian power reactors which have been submitted for review have been declassified. In addition, some reports concerning military reactors and production reactors have also been declassified.

The special review program which was held in Oak Ridge between February and June of 1957 was designed to make available for public dissemination all of the information known to exist in the Commission's files which fell within the provisions of the new declassification policy. A separate report of that review was made to the Joint Committee on July 3, 1957.

Since that time civilian power reactors have been placed in the unclassified fields of research. The latest addition to the list of such reactors is the merchant-ship reactor. Commission contractors operate under specific instructions requiring the prompt and full reporting of research results. All reports containing useful technical information are furnished the AEC's Technical Information Service for distribution within the national atomic energy program and among science and industry generally. Special efforts have been made to assure that information, however fragmentary, developed within the military reactor programs has been made available for Commission review and dissemination. In this connection laboratory files have been carefully screened to select out all useful material.

The preparation and distribution of written reports on progress of research projects requires time. Commission staff continually review the reporting efforts of AEC contractors to keep unnecessary delays from developing and thereby assure prompt reporting.

In the naval and aircraft propulsion programs, specific efforts have been initiated to originate reports as unclassified by preparing them in such a manner as to separate technology from design information. For example, an unclassified technical review journal is being issued bimonthly from the Bettis plant. At Lockland classified ANP technical reports have been grouped into comprehensive reports which have been declassified and broadly distributed.

After completion of the 1957 rapid declassification review, the Commission established a program for editing, rewriting, and publishing reports on military reactors which reviewers decided could be declassified with deletions. Some 175 of the deleted reports containing currently useful information have been edited or rewritten and reissued. On February 14, 1958, the General Manager of the Commission sent to the executive director of the committee an extensive review of new developments in, and the current status of, all phases of the technical information program.

We do recognize, however, that the availability of information to industrial, research, and educational institutions is a problem requiring continuous scrutiny. The Commission is further reviewing its policy and procedures for making such information available in an effort to determine whether further improvements can be made.

We believe our joint discussions have been very profitable and that steady progress is being made toward developing a program which both your committee and the Commission can support.

Sincerely yours,

W. F. LIBBY, *Acting Chairman.*

APPENDIXES

APPENDIX 1

CONGRESS OF THE UNITED STATES

JOINT COMMITTEE ON ATOMIC ENERGY

RESEARCH AND DEVELOPMENT SUBCOMMITTEE

SUMMARY OF SEMINAR WITH REACTOR EXPERTS, NOVEMBER 21, 1957

On November 21, 1957, a closed informal seminar was held in room F–88, the Capitol.

On the basis of this seminar, of which no transcription was taken, the following conclusions were reached:

1. There is today no clear-cut Government program with regard to atomic-power development. We need clear-cut national objectives, both with respect to domestic and international development.

2. The AEC power demonstration program, as it now exists, is not by itself proving adequate for the work that has to be done. Additional funds and efforts will be required if we are to develop nuclear power technology at a rate sufficient to meet the needs of national and international policies.

3. Private industry alone cannot carry the full load in developing and constructing reactors. More Government support and money is necessary.

4. Availability of technical manpower is not today a limiting factor in developing reactor technology. There are, however, some instances where temporary shortages of highly skilled people occur but these deficiencies are in cases where the skills can only be acquired through work and experience in the field itself.

5. The Government should determine and firm up how much money it is willing and plans to spend within the next several years in the civilian power program. (This could be a 5-year or a 10-year plan or comparable.) Once having made that determination and it is known how much money will definitely be allocated to the program over a given period of time, details can then be worked out as to how the money will be spent to cover the various elements of the program.

6. In developing reactor technology it is necessary to build reactors large enough to develop the necessary technical information and there must be several succeeding generations of a given type if we are to prove out that type. In building full-scale reactors it is usually necessary to go through the following steps:

(*a*) Small experimental model;
(*b*) Intermediate size; and
(*c*) Full-scale project.

It will be only after several succeeding generations of full-scale reactors of a given type before we will succeed in reaching or approaching the stage where the economic value of a reactor concept can be determined.

7. We should continue to give strong support to advanced reactor concepts and the necessary research and development work involved in these advanced concepts. We must not drop them or cut back on them to specialize only on the water types.

8. Additional research and testing reactors (similar to MTR and ETR) need be built by the Government. We cannot depend entirely upon private industry to build and support research and test facilities. This includes hot cells and supporting equipment. Industry often has excess capacity in its own facilities but competitive considerations have a tendency in some instances to discourage the use of one firm's facilities by another.

9. The Government must support wide engineering research of a type that cuts across the entire field and is not limited to one of several particular reactor

concepts. Such research is an essential part of our reactor development effort and should be utilized to the maximum to prove out materials and components which would otherwise have to receive their preliminary tests in more costly full-scale reactors.

10. There are too many small "subcritical" research and development organizations in the nuclear-power field at the present time, which tend to dilute effort and trained manpower. Some suggestions were made as to consolidating efforts through joint enterprises comprised of several organizations.

APPENDIX 2

CONGRESS OF THE UNITED STATES

JOINT COMMITTEE ON ATOMIC ENERGY

RESEARCH AND DEVELOPMENT SUBCOMMITTEE

SUMMARY OF SEMINAR WITH REPRESENTATIVES OF EQUIPMENT MANUFACTURERS, NOVEMBER 22, 1957

The Research and Development Subcommittee held an informal seminar November 22 with representatives of the equipment manufacturers to discuss the nuclear power program. No transcript was made of the proceedings, which were held in the committee room at the Capitol.

Following are some of the major points covered:

1. Need for well-defined policy

There was unanimous agreement among the participants, as there was at the reactor experts seminar the previous day, that the most pressing requirement at the present time is a clear and well-defined statement of this country's policy in the nuclear power field, both from a domestic and international point of view. It was agreed that such a statement of policy by the Government is a necessary prerequisite to the development of an intelligible and effective program of action to further this country's objectives. Without such guidance participants in the program cannot move forward confidently and the program has a tendency to drift rather than move vigorously ahead.

2. Desirability of fixed-price contracts

There was virtually unanimous agreement that the concept of fixed price contracts for research and development work is unworkable and undesirable. It was pointed out that research and development necessarily implies a high degree of uncertainty in initial cost estimates, and that it is not reasonable to expect the manufacturer to absorb the entire difference between original estimates and final costs, particularly where such differences may range up to 100 percent or more. It was suggested that cost-type of contracts were more suitable for the construction of first generation prototype nuclear powerplants, which involve considerable research and development costs. It was also felt by some that the "buying-in" concept by which the manufacturer contributes a portion of the funds for a powerplant project was not desirable as it limited manufacturer participation to those companies with large financial resources.

3. Desirability of subsidies

Several participants suggested that direct Federal subsidies would be desirable as a means of accelerating the atomic power program. Such subsidies could take the form of payment by the Government of the difference between the costs of conventional powerplants and nuclear plants, either in full or in part. Another suggestion was that the subsidy be based on a fixed payment for kilowatts actually produced, although this received little support by the group. Both suggestions, to be carried out, would require amendment of the no-subsidy provision of the 1954 Atomic Energy Act.

4. Shortage of manpower

It was generally agreed that there does not now exist any real shortage of scientific and engineering manpower in industry. It was noted that all companies traditionally run slightly short of such manpower as a matter of good management, and in some instances temporary difficulty is experienced in finding exactly the right man for a given technical assignment. As a general proposition, however, the manufacturers consider present supplies of manpower ade-

quate and in some cases surpluses are developing where business has slacked off. All agreed that the present adequacy of manpower supplies in no way detracted from the long-term need for skilled manpower and for improvements in our educational system to insure that our young people have the necessary preparation to pursue careers in science and engineering.

5. Need for more test equipment

It was generally agreed that progress in atomic power development rests in considerable degree on preliminary studies and performance data on component parts derived from experimentation in engineering and test reactors, and other large testing equipment. This is particularly true, it was pointed out, in the case of fuel elements. There was some division of opinion as to whether additional equipment should be provided in the national laboratories or whether industry should expand its own facilities. It was noted, in this connection, that excess capacity may exist in test equipment being constructed by private industry but that competitive considerations often inhibit one firm from utilizing the facilities of another firm for test purposes.

6. Technical information program

It was felt that the Commission's technical information program is in general adequate although there was some feeling that there is still considerable material in laboratory files which has not yet been made available. Particular reference was made to the difficulties being encountered by some interested firms in obtaining information on reactor development from the Naval Reactors Branch of the Commission. Reasons given by the Naval Reactors Branch for refusing access to such information have been security considerations and also unwilling ness to devote the necessary time to informational activities. Some difficulty is also being experienced in gaining information on the aircraft nuclear propulsion program.

7. Reactor markets abroad

It was pointed out by several participants that there is considerable misunderstanding regarding the prospects for sales of American reactors abroad. Too often we tend to think of the needs of other countries in American terms rather than in terms of what is actually required by the particular country involved. Thus, in a number of instances, the export of American know-how and cooperation with scientists and engineers in a given foreign country will be more important than the export of actual equipment. There are few cases anticipated where entire reactors, including building materials, will be exported. However, it was pointed out that a certain amount of equipment will inevitably be connected with the export of know-how and that, therefore, over a period of time there will be a demand for substantial quantities of hardware in the form of component parts. It was felt that greater progress would be made in the foreign market through cooperative arrangements worked out between American and foreign industry than on a government-to-government basis, as in the case of the British.

8. Indemnity coverage for reactors abroad

It was generally suggested among those equipment manufacturers doing business abroad that the lack of insurance/indemnity coverage for American firms is serving as a deterrent to them in considering foreign sales. However, no one had any answer to the observation that Government and power operators in foreign countries were satisfied that the insurance problem could be solved without United States legislative intervention.

APPENDIX 3

[Reprinted from the Forum Memo of the Atomic Industrial Forum, Inc., February 1958]

Forum poll favors expansion

On December 17 the Atomic Industrial Forum, mindful of the atomic power policy debate that has been underway in the United States for the past 2 years, polled its 425 domestic organization members to attempt to find out what they believe the general shape, size, and nature of the United States effort to achieve economic atomic power should be. The answers came in last month.

The response was heavy, totaling 240, or approximately 56 percent of the organizations polled. Of these 232 completed the questionnaire in sufficient

detail to permit their responses to be included in the tabulation of results. The other eight respondents said they either had no opinion on the basic questions of the poll, did not feel they were qualified to answer, or disagreed with the poll's method.

Of the 232 organizations which responded meaningfully to the poll, 25 percent were manufacturers of atomic products, 17 percent were architect-engineer, construction or consulting firms, 17 percent were research organizations or universities, 12 percent were utilities, and 10 percent were financial, legal or insurance firms. The remaining 19 percent included chemical, mining, and petroleum companies, transportation equipment manufacturers, miscellaneous manufacturers and others.

Expanded program favored

One hundred and sixty-one organizations, representing 69 percent of the total respondents, said they believed that United States atomic power development activity should be expanded. Of the remaining 31 percent, consisting of 71 respondents, 24 percent indicated that development should be maintained at present levels, 3 percent suggested that it should be reduced from present levels and 4 percent offered no opinion.

As to the question of whether any expansion activity, whether undertaken by the Government, by industry, or by industry with Government assistance, should be formalized in a new national atomic power program defined in such terms as kilowatts, dollars, or years, 62 percent of the respondents said yes, 33 percent said no and 5 percent had no opinion.

Program ingredients

Although Forum members suggested a variety of ways as to how an expansion program of atomic power activity should be shaped up, leading opinion suggested the following:

An expansion program should be undertaken in part through the following steps in this order: (1) Government-sponsored research and development activity in non-Government facilities, (2) modification of Government procurement policies and practices to increase economic incentives, and (3) Government-sponsored research and development in national laboratories.

As to the types of research worth emphasizing, fuel technology, advanced reactor concepts, and chemical reprocessing were considered the three most important in order.

If increased Government assistance is extended to reactor manufacturers and/or operators of atomic powerplants, it should be aimed first at preconstruction research and development, second at fuel prices, and third at fuel reprocessing charges.

Of various forms of assistance to United States exporters of atomic goods and services, the three considered most important were: indemnification against third-party liability, guaranteed prices over a long term of years for enriched uranium and plutonium, and further declassification of information on reactor technology.

As to which special priority programs should be instituted in light of recent Soviet Union achievements in science and technology, basic nuclear research ranked first, means to utilize fusion energy ranked second, and advanced type fission reactors was third.

Program outlined

There was a somewhat wider divergence of opinion on how an assumed new national program should be defined. The consensus opinion, however, produced the following criteria:

"Years" was regarded as the most important benchmark with "reactor types" and "money" next in order.

There was an almost equal split in opinion between 5 and 10 years as the number of years over which a new national effort should be extended, suggesting almost unanimous agreement on a 5–10 year program.

As to kilowatt goal, "three million" electrical kilowatts led to the list of possible selections but was closely followed by "two million" ekw and the suggestion that there be no kilowatt goal.

The largest number of respondents indicated that $1 billion to $2 billion in public funds should be specified for such a program, with expenditures of $500 million to $1 billion and $250 million to $500 million next in order.

The largest number of respondents selected 100,000 to 300,000 ekw as the reactor size which should be emphasized, although this was closely followed by the

suggestion that emphasis be placed on a combination of 2 sizes, such as 40,000 ekw or less and 100,000 ekw to 300,000 ekw.

There was less agreement on what reactor types should be emphasized than on any other question in the poll, although the 3 types most frequently suggested in order of preference were: light water cooled and moderated, fast breeder, and gas cooled.

A nearly 2-to-1 majority thought that the United States should now undertake a natural uranium reactor program. The opinion was also indicated that such a program, if undertaken, should include so-called dual purpose reactors.

The complete results of the poll, giving weighted totals and comparable percentages by categories of respondents, are given in the accompanying table.

Forums opinion poll results

[Except for cols. (7) and (8), each column below has 2 numbers in each line, 1 preceding a hyphen and 1 (in italic) following it. The 1st number represents the votes received by the indicated answer; the italicized number represents this vote translated into a percentage of the total. In some cases respondents were asked to vote for several answers in order of preference. Where this was done the vote is a weighted total calculated as explained in the last footnote on p. 18. In col. (7) the number in parentheses represents the actual total number of mentions the answer received not counting preference]

	Utility (1)	Manufacturer of atomic products [1] (2)	Architect-engineering-construction-consulting [2] (3)	Universities—research [3] (4)	Financial-legal-insurance [4] (5)	Other [5] (6)	Total or weighted total [6] (7)	Percent (8)
Number of respondent organizations	28	58	40	39	22	45	232	------
Comparative percentages—percent	*12*	*25*	*17*	*17*	*10*	*19*	----------	------
QUESTIONS AND ANSWERS								
Do you believe that United States atomic power development should be:								
Reduced	2-*7*	1-*2*	1-*2*	1-*3*	--------	2-*5*	7	*3*
Maintained	11-*39*	12-*21*	9-*23*	4-*10*	6-*27*	14-*31*	*56*	*24*
Expanded	13-*47*	43-*74*	30-*75*	31-*79*	16-*73*	28-*62*	161	*69*
No answer	2-*7*	2-*3*	--------	3-*8*	--------	1-*2*	8	*4*
Do you believe that any expansion activity should be formalized in a new national atomic power program?								
Yes	13-*46*	46-*79*	26-*65*	21-*54*	11-*50*	27-*60*	144	*62*
No	14-*50*	11-*19*	13-*33*	13-*33*	9-*41*	17-*38*	77	*33*
No answer	1-*4*	1-*2*	1-*2*	*5-13*	2-*9*	1-*2*	11	*5*
Assuming expansion is undertaken, how should such expansion be accomplished? [7]								
Government-sponsored R. and D. in non-Government facilities	105-*90*	227-*22*	159-*23*	193-*29*	78-*22*	163-*22*	925(185)	*23*
Modification of Government procurement policies and practices	61-*12*	205-*20*	148-*21*	103-*15*	59-*17*	120-*17*	696(146)	*18*
Government-sponsored R. and D. in national laboratories	98-*19*	117-*12*	84-*12*	114-*17*	48-*13*	124-*17*	585(131)	*15*
Government assistance to operators of atomic powerplants	81-*16*	102-*10*	83-*11*	50-*8*	44-*12*	56-*8*	416(114)	*10*
Construction of Government-owned experimental and prototype reactors	46-*9*	88-*9*	40-*6*	77-*11*	25-*7*	92-*13*	368(104)	*9*
Investment by utilities	44-*8*	31-*3*	43-*6*	23-*3*	12-*4*	36-*5*	189(59)	*5*
Government assistance to reactor manufacturers	32-*6*	56-*6*	34-*5*	21-*3*	27-*8*	15-*2*	185(57)	*5*
Investment by manufacturers	25-*5*	17-*2*	24-*3*	17-*3*	*5-1*	45-*6*	133(41)	*3*
Export subsidies to United States equipment suppliers	3-*1*	40-*4*	25-*4*	16-*2*	16-*5*	16-*2*	116(39)	*3*
Third party liability protection abroad	9-*2*	30-*3*	21-*3*	13-*2*	*5-1*	15-*2*	93(32)	*2*
Construction of small Government-owned powerplants	1	31-*3*	6-*1*	20-*3*	8-*2*	24-*3*	90(28)	*2*
Construction of large Government-owned powerplants	--------	33-*3*	*5-1*	18-*3*	22-*6*	4-*1*	82(25)	*2*
Foreign-aid programs with "buy America" provisos	*5-1*	22-*2*	24-*3*	1	4-*1*	16-*2*	72(24)	*2*
Other	*5-1*	14-*1*	9-*1*	4-*1*	4-*1*	--------	36(8)	*1*

See footnotes at end of table.

Forums opinion poll results—Continued

	Utility	Manufacturer of atomic products [1]	Architect-engineering-construction-consulting [2]	Universities—research [3]	Financial-legal-insurance [4]	Other [5]	Total or weighted total [6]	Percent
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
QUESTIONS AND ANSWERS—con.								
Assuming increased Government assistance to reactor manufacturers and/or operators, which assistance route should be extended? [7]								
Preconstruction R. and D	142–28	211–24	147–22	173–34	63–24	155–26	891(170)	26
Fuel prices	86–17	122–14	111–16	53–10	49–19	77–13	498(120)	14
Fuel reprocessing charges	82–16	102–12	90–13	51–10	36–14	69–11	430(114)	12
Contribution to capital costs: Based on difference in nuclear and conventional costs	53–10	119–14	77–11	56–11	26–10	87–14	418(90)	12
Special tax amortization rates	21–4	142–16	59–9	60–12	42–16	82–14	406(99)	12
Postconstruction R. and D	51–10	72–8	87–13	64–12	25–9	64–11	363(91)	11
Plutonium buy-back prices	77–15	63–7	80–12	34–6	21–8	43–7	318(92)	9
Contribution to capital costs: Based on fixed sum per installed kilowatt	.....	38–4	10–2	19–4	.....	23–4	90(20)	3
Other	.....	.....	12–2	.....	.....	.....	12(2)	.....
Other	.....	13–1	3	4–1	.....	3	23(5)	1
Assuming a new national program is adopted, how should such a program be defined?								
Years	18–22	44–23	31–27	22–25	7–15	30–24	152	23
Reactor types	20–25	35–18	21–18	19–22	14–29	24–19	133	20
Money	13–16	30–16	23–20	15–17	9–18	19–15	109	17
Cost per kilowatt-hour	13–16	29–15	13–11	12–13	6–12	29–23	102	16
Reactor sizes	10–12	25–13	13–11	12–13	9–18	14–12	83	13
Kilowatts	7–9	26–14	12–11	8–9	4–8	9–7	66	10
Other	.....	2–1	2–2	1–1	.....	.....	5	1
How many years should a new national program cover?								
10 years	17–61	26–45	18–45	18–46	3–15	19–42	101	43
5 years	8–28	29–50	15–37	16–41	12–55	20–45	100	43
3 years	.....	.....	2–5	1–3	1–5	.....	4	2
Other	.....	.....	.....	.....	2–9	2–4	4	2
None	1–4	1–2	.....	.....	1–5	.....	3	1
No answer	2–7	2–3	5–13	4–10	3–13	4–9	20	9
How large an electrical kilowatt goal should be set for such a program?								
3,000,000 kilowatts	3–11	13–23	8–20	6–15	5–23	7–16	42	18
2,000,000 kilowatts	7–25	13–22	6–15	6–15	1–5	6–13	39	17
None	10–36	6–10	6–15	3–8	5–23	9–20	39	17
5,000,000 kilowatts and more	2–7	11–19	2–5	5–13	3–13	3–7	26	11
1,000,000 kilowatts or less	2–7	4–7	5–12	1–3	.....	5–11	17	7
No answer	4–14	11–19	13–33	18–46	8–36	15–35	69	30
What amount of public funds should be specified for such a program?								
$1,000,000,000 to $2,000,000,000	3–10	19–33	8–20	6–15	2–9	13–29	51	22
$500,000,000 to $1,000,000,000	5–18	14–24	10–25	6–15	2–9	7–16	44	19
$250,000,000 to $500,000,000	5–18	8–14	8–20	4–10	2–9	5–11	32	14
$100,000,000 to $250,000,000	3–10	4–7	4–10	2–5	2–9	4–9	19	8
More than $2,000,000,000	1–4	3–5	.....	3–8	5–23	3–7	15	7
$100,000,000 or less	1–4	.....	.....	1–3	1–5	2–4	5	2
None	1–4	1–2	2–5	.....	1–5	.....	5	2
No answer	9–32	9–15	8–20	17–44	7–31	11–24	61	26
What reactor sizes, if any, should be emphasized?								
100,000 to 300,000 ekw	6–21	15–26	8–20	6–15	5–23	7–16	47	20
Combination of 2 sizes	3–10	18–31	8–20	8–21	5–23	3–7	45	19
40,000 to 100,000 ekw	5–18	7–12	8–20	8–20	4–18	9–20	41	18
40,000 ekw or less	7–25	7–12	7–17	7–18	.....	9–20	37	16
300,000 ekw and more	1–4	3–5	1–3	.....	1–5	1–2	7	3
None	1–4	.....	3–8	.....	.....	2–4	6	3
No answer	5–18	8–14	5–12	10–25	7–31	14–31	49	21
What reactor type, if any, should be emphasized? [7]								
Light water cooled and moderated	45–10	144–20	118–23	71–18	30–14	57–13	465(90)	17
Fast breeder	94–22	109–15	80–15	63–16	29–14	63–14	438(99)	16
Gas cooled	37–9	103–14	58–11	71–18	31–15	62–14	362(84)	14
Homogeneous	55–13	84–11	49–9	44–11	21–10	57–13	310(73)	11
Heavy water moderated	18–4	94–13	65–13	27–7	17–8	33–8	254(63)	10
Plutonium recycle	68–16	52–7	37–7	26–6	18–9	43–10	244(62)	9
Liquid metal fueled	58–13	34–5	30–6	33–8	21–10	37–8	213(58)	8
Organic moderated	15–3	25–3	43–8	32–8	14–7	35–8	164(43)	6

See footnotes at end of table.

Forums opinion poll results—Continued

	Utility	Manufacturer of atomic products [1]	Architect-engineering-construction-consulting [2]	Universities—research [3]	Financial-legal-insurance [4]	Other [5]	Total or weighted total [6]	Percent
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
QUESTIONS AND ANSWERS—con.								
What reactor type, if any, should be emphasized? [7]—Continued								
Sodium cooled	17–4	36–6	13–3	14–3	21–10	16–4	117(32)	4
Graphite moderated	20–5	34–5	25–5	15–4	6–3	16–4	116(33)	4
Other	3–1	16–2	———	4–1	———	17–4	40(8)	1
Should the United States undertake a natural uranium reactor program?								
Yes	16–67	29–50	20–50	23–59	14–64	27–60	129	56
No	9–32	21–36	14–35	8–21	4–18	11–24	67	29
No answer	3–11	8–14	6–15	8–20	4–18	7–16	36	15
If so, should dual purpose reactors be included:								
Yes	12–43	21–36	20–50	18–46	11–50	18–40	100	43
No	7–25	14–24	8–20	6–15	4–18	8–18	47	20
No answer	9–32	23–40	12–30	15–39	7–32	19–42	85	37
Which of the following types of research should be emphasized? [7]								
Fuel technology	146–30	229–37	177–30	113–23	87–30	160–26	912(180)	27
Advanced reactor concepts	109–26	221–36	124–21	113–23	76–26	173–28	816(182)	25
Chemical processing	105–22	185–22	120–20	111–23	51–18	141–22	713(155)	22
Reactor safety	54–11	123–15	101–17	75–16	42–14	92–15	487(118)	15
Plutonium chemistry	68–14	66–8	62–11	34–7	34–12	49–8	313(88)	9
Other	1——	16–2	7–1	37–8	———	9–1	70(16)	2
Which form of assistance to U. S. exporters of atomic products and services is most important? [7]								
Indemnification against 3d party liability	72–24	177–24	123–22	65–17	68–23	98–25	603(123)	22
Guaranteed prices for enriched U and Pu	56–19	129–18	125–22	67–17	55–19	57–15	489(103)	18
Further declassification of reactor technology	68–23	93–13	78–13	66–17	53–18	89–23	447(95)	17
Financial assistance to other countries	37–12	123–17	91–16	61–16	43–15	39–10	394(86)	15
Government assistance for construction of reactors abroad	33–11	97–13	73–13	49–13	31–11	57–15	340(77)	13
Removing 20 percent fuel enrichment limitation	24–8	67–9	32–6	52–13	18–6	27–7	220(54)	8
Government guaranties of fuel performance	9–3	37–5	39–7	27–7	24–8	13–4	149(37)	6
Other	———	4–1	6–1	———	———	5–1	15(3)	1
In view of recent Soviet scientific achievements, on which should priority programs be instituted? [7]								
Basic nuclear research	88–22	223–22	147–21	171–27	82–23	185–26	896(189)	24
Means to utilize fusion energy	50–13	187–18	113–17	147–23	81–23	160–22	738(178)	19
Advanced type fission reactors	99–25	179–17	114–17	81–13	56–16	116–16	645(162)	17
Nuclear powered rockets and missiles	58–15	178–17	114–17	98–16	55–16	105–15	608(138)	16
Reactor types in existence or planned	52–13	151–15	107–16	53–9	40–11	76–10	479(119)	13
Nuclear powered aircraft	17–4	103–10	64–9	53–9	27–8	60–8	324(99)	9
Other	13–3	6–1	9–1	17–3	10–3	7–1	62(14)	2
None	18–5	———	12–2	———	———	12–2	42(7)	1

[1] Includes 11 reactor manufacturers; 24 manufacturers of reactor materials, components and/or accessories; 10 manufacturers of reactor fuel and/or fuel elements; and 13 manufacturers of instruments and/or control equipment.

[2] Includes 28 architect-engineers and/or constructors; 4 management consultants; and 8 technical consultants.

[3] Includes 17 research organizations; and 22 universities.

[4] Includes 10 financial organizations; 5 legal firms; and 7 insurance organizations.

[5] Includes 7 petroleum companies; 6 chemical firms; 5 mining firms; 8 firms associated with the transportation industry; 9 manufacturers of miscellaneous products; 5 unidentified; and 5 miscellaneous.

[6] Where numbers used in reporting the response to a particular question add up to more than the number of respondents in the particular category, they are weighted totals.

Where weighted totals are used, respondents were asked to supply answers in 1, 2, 3 order. In most cases, respondents supplied 6 preferences; hence, all 1st place answers were assigned 6 points, 2d place answers, 5 points, etc. The addition of the assigned points gives the indicated weighted totals.

Numbers within parentheses refer to number of responses contributing to weighted total, regardless of order. Where weighted totals are not used, numbers refer to number of responses.

[7] Vote is weighted to show preference.

Comments

Each respondent was asked to explain why he believed that United States atomic power development activity should be reduced, maintained, or expanded from present levels. Among the reasons cited by those who believed that atomic power development activity should be expanded from present levels were:

A reactor manufacturer.—"Under normal circumstances, we believe that the atomic power industry should be expanded through the normal forces of economic pressures and growth. However, the realities of the present international situation would seem to dictate that the United States should obtain a position of leadership in the development of nuclear power. This seems to be so because of the prestige value associated with this new industry and because of our past close association with the nuclear weapons program. To obtain a position of world leadership an expanded effort will certainly be required."

A utility company.—"[We should expand our atomic power development activity] to advance the time when nuclear power will become competitive in the United States; to maintain our lead in this field; and to support the atoms-for-peace program."

A fuel manufacturer.—"We believe that an expansion of our domestic program is necessary to demonstrate concretely to our foreign allies that our leadership in this field is very real and unmatched by other nations. We recognize that such an expansion is unjustified based upon our domestic needs for power and is probably unjustified as a method of conserving our fossil fuel resources."

A technical consultant.—"The fellow who wants a big power program has more cents than sense. What we need is more know-how, more research with more dollars, and much more sense."

A university.—"We have depended on initiative from private industry beyond what it can or will give. Our progress has been too slow to date largely on this account. We should encourage and assist private industry, research, and university groups so as to bring in new talent, as well as expand the direct Government effort."

More comment

From among those who indicated that the present level of effort should be maintained there came the following comments:

A reactor manufacturer.—"The demand for domestic development is small and a proper consideration of United States foreign needs can probably be well cared for by our present rates of development which is all the tax money we should spend."

A utility firm.—"At the present time utilities and manufacturers have engaged financial, facility, and personnel resources at a level which approaches a reasonable top commitment, in view of the present state of development. Time is required to complete these projects and assimilate findings in order to determine which reactor concepts justify increased development."

An insurance company.—"We believe that more can be accomplished by an orderly development at present levels rather than at levels dictated by national and international hysteria, political interests, and the interests of groups with slanted viewpoints."

And finally, from those who suggested a reduction in atomic power development from present levels, came these views:

A utility firm.—"While economic atomic power is a desirable goal, there are other objectives more deserving of the excess effort needed to gain only a little earlier atomic success. 'Prestige' appears to have too high a price tag. Foreign markets do not appear permanent because of atomic power's high labor content."

An engineering firm.—"If by 'United States' you mean the Federal Government, I believe in private enterprise and want the Government to get out of competitive business."

A petroleum company.—"Power supplies are adequate; a high rate of nuclear development will bring about an inefficient Government-subsidized atomic-power industry to compete with more efficient plants."

Contract relations

A supplementary part of the forum poll was designed to produce information on contractual relations between Government and the atomic industry, including problems previously identified by the forum's committee on financial practices. This part of the poll also served as a followup to the results of the forum opinion poll of a year ago which identified "lack of economic incentive" as the principal obstacle inhibiting the growth and development of the atomic industry.

Participation in this part of the poll was necessarily more limited than the earlier part since it was intended only for those respondents holding AEC contracts. The 68 returns represented 12 reactor manufacturers, 9 reactor fuel manufacturers, 18 manufacturers of reactor materials, components and/or accessories, 13 architect-engineering firms, and 16 miscellaneous organizations, and produced the following information:

Thirty-four companies, including 11 of the 12 reporting reactor manufacturers, indicated that "lack of economic incentive" was the chief deterrent to the growth of atomic activities in their organizations. Seventeen companies listed it as a major deterrent, 13 designated it as a minor deterrent, 3 said it was not a deterrent, and 1 respondent expressed no opinion. The total 68 respondents reported that on an average over 60 percent of their atomic energy activities last year were carried out under prime or subcontracts with the Government.

4. Shortage of manpower

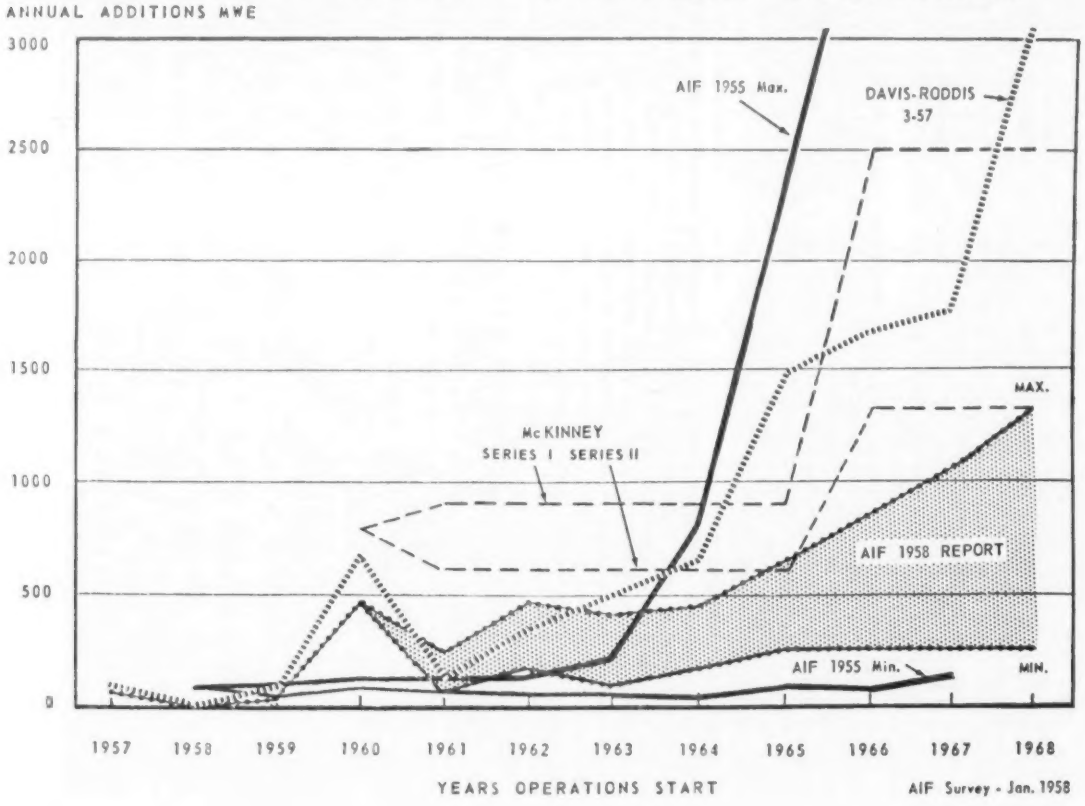
As to the factors contributing to a lack of economic incentive, the most frequently mentioned one, indicated by 61 respondents and receiving 41 percent of the weighted vote, was "lack of prospects for private sales in the short term." "Insufficient return from Government contracts" ranked second and received 30 percent of the weighted vote. (Attention is called to a possible correlation between this opinion and the poll result presented above indicating that "modification of Government procurement policies and practices to increase economic incentives" is the second most important way of accomplishing an expansion in atomic power development activity.)

Of 30 respondents supplying information on profit and loss from atomic energy activities, average profits for the last fiscal year, excluding reactor manufacturers, amounted to 3.8 percent of total atomic energy revenues. Four of nine reactor builders reported profits ranging from 1.5 percent to 10 percent while 5 reported losses up to 168 percent.

Of 48 respondents reporting on whether they incurred items of cost during the last fiscal year which they considered to be properly allocable to their AEC contract work under generally accepted accounting principles, but which were disallowed by AEC, 26 companies reported "yes" and 22 reported "no." Thirteen companies said that certain items had been allowed under some AEC contracts and disallowed under others. Sixteen respondents reported that some items disallowed by AEC were of a kind customarily allowed under contracts which their companies held with other Government agencies. Most frequently mentioned as being disallowed by AEC were the general categories of "overhead" and "general and administrative expenses." The specific items mentioned most often were, in order: general research and development, advertising and public relations, depreciation, and marketing expense.

The responses showed no special preference for fixed price contracts as compared to those with an incentive basis or cost reimbursement basis; however, nearly all respondents reported interest in increasing their atomic energy business on Government contract.

U.S. FUTURE CONSTRUCTION—LARGE NUCLEAR POWER STATIONS



This chart illustrates the various predictions that have been made concerning the number of atomic megawatts expected to be installed in the form of large-scale powerplants annually in the United States until 1968. The chart, among other things, shows that the Atomic Industrial Forum's new growth survey (shaded area) predicts a maximum amount of activity by 1968 that is approximately equal to the minimum amount of activity predicted 2 years ago by the McKinney panel (dotted lines), and not quite half the amount predicted in March 1957, by AEC Reactor Director W. Kenneth Davis and his deputy, Louis Roddis. The very widely spread heavy black lines represent the minimum and maximum levels predicted by the Forum's 1955 Growth Survey. Both the 1955 and 1958 growth surveys of the Forum were conducted independently under contract by Pickard-Warren-Lowe Associates of Washington, D. C.

A NEW GROWTH SURVEY

Last month the atomic industrial forum completed its second growth survey of the atomic industry. The first covered the years 1955–65; the new one covers the years 1958–68.

The new survey report, which has been in preparation for a year under contract with the consulting firm of Pickard-Warren-Lowe Associates, updates and reevaluates the business forecasts contained in the first report. Taking account of recent reactor developments as well as new technological problems and rising cost estimates, the survey addresses itself to 4 principal areas of the nuclear reactor industry: (1) rate of construction of nuclear reactors in the United States, (2) nuclear plant and component costs and markets, (3) foreign nuclear reactor activities, and (4) reactor fuel cycles. The report concerns itself only with those activities of the atomic industry having a direct or indirect relationship with the development of nuclear reactor systems and installations.

The new report is based on data collected from 15 major United States manufacturers of nuclear reactor systems and components, from 12 companies which have either contracted to install and operate power reactor plants or which in some other way are intimately associated with atomic energy development, and from several Federal Government agencies, principally the Atomic Energy Commission. Data assembled in an attempt to measure the overseas market was collected in interviews with European atomic energy authorities during a specially arranged tour of European facilities.

Overall results

As shown in the accompanying chart, the growth predictions of the new survey lie between those of the earlier survey and produce an estimate that from 250,000 to 1,300,000 kilowatts will be added annually in the United States by 1968. Interestingly, the earliest date of economically competitive power on a maximum growth basis is now estimated at 1964, 2 years later than the corresponding estimate of the first report. Equally interesting, the maximum growth prediction contained in the new survey as of 1968 is approximately the same as the minimum growth prediction of the McKinney panel report published in 1956.

The report also shows that the nuclear industry is now building toward the installation of more than one-half million kilowatts of nuclear power capacity by 1960. The report concludes that if the present level of Government and industry investment in uneconomic reactor facilities is continued, an economically competitive plant may be achieved by 1964. If, in turn this is accomplished, the resulting growth could, under optimistic assumptions, produce a total United States power reactor capacity by 1968 of about 6 million electrical kilowatts. Under pessimistic assumptions, the report says, an economic plant would not appear until after 1968 and a capacity of only about 2 million kilowatts would be built by 1968. The report cautions that estimates of the potential volume of economic nuclear powerplants constructed in the next decade are highly sensitive to minor variations in attainable costs of nuclear power, and says that when approaching the economic range, an upward variation in nuclear power costs over estimates of only 1 mill per kilowatt-hour could reduce the megawatts of projected installations by nearly 50 percent.

The report estimates that expenditures for support of civilian power reactor development, on the basis of present commitments, will total $150 to $180 million annually until 1960–61. Of this annual total, $90 million to $100 million are expected to be contributed by the United States Government, $50 million to $60 million by private utility firms, and $10 million to $20 million

by manufacturers of reactors and reactor components. The report points out that an equivalent rate into the 1960's would provide a level of experimental work and new construction sufficient to insure substantial technological progress for the industry.

As to reactor types, the report says: "It is to be expected that the water-cooled reactor units will dominate the choices for construction in the United States throughout the approximately 10-year period covered by this report. The dominant position which the water-type units will occupy until the mid-1960's, however, begins then to change gradually as other types are more fully engineered." The report picks no "winner for second position" but does add: "At present the liquid metal, homogeneous and fast breeder types are receiving the strongest development support because of their long-term economic promise. At the same time, however, the physical problems to be solved in connection with these plants are probably greater than those of the heavy water and low tempertaure gas-cooled types which so far are not as heavily supported in this country."

As for the construction of naval, military, and maritime propulsion reactors, the report expects these to increase at a steady rate during the next decade, with the Navy's share amounting to about 90 percent of the total. When the first surface ship units go into operation in 1960, the total installation of naval reactors will be approximately 200 electrical megawatts per year, and may increase to more than 3 times this rate by 1968.

Costs and markets

The report notes that, during the past 2 years, capital cost estimates for nuclear-power projects have increased markedly for such reasons as additional development costs to solve unexpected technical problems, additional engineering to achieve satisfactory reactor system designs, unique specifications required of nuclear components, and general escalation of prices of both nuclear and conventional materials and equipment. Taking such typical items as pumps, valves, heat exchangers, and some vessels for specified nuclear requirements, increases between 1955 and 1957 quotations have been as high as 115 percent or more.

The report points out, however, that whereas rising estimates have been the rule of the day, many of the factors which are most likely to achieve reductions have not had a full opportunity to operate on current costs. The report concludes that both industry opinion and independent analyses indicate that costs will probably not experience further increases, but that results of continuing development and added experience will yield reductions of 15 to 35 percent in terms of 1957 dollars in the 1960–68 period. Consequently, whereass the composite mean capital cost of the large nuclear powerplants to start operations in 1960, including those being built for Commonwealth Edison, Consolidated Edison, Power Reactor Development, and Yankee Atomic Electric, is estimated at about $430 per electrical kilowatt, including indirect costs with interest during construction, comparable figures for similar plants to start operations in 1968 are estimated by the report at between $280 and $360.

The report states that, because of the lead times involved and the number of reactor projects now committed, the number of nuclear-power installations completed in 1961 may be less than half of those going into operation in 1960. The report estimates, however, that the annual dollar volume of sales for United States large nuclear reactor systems, exclusive of turbogenerator plants and their accessories, will increase from approximately $300 million in 1960 to a probable range of from $350 million to $660 million in 1968. Of these totals, the naval, military, and propulsion group of reactors comprise from 40 to 80 percent, excluding any expenditures for the aircraft nuclear-propulsion program which may be sizable but more speculative.

The report also estimates that in the early 1960's, the annual dollar volume of business in small reactors, including power prototypes, research, and test reactors with rated capacities of less than 25 mwe, will rise to a level which will temporarily equal or exceed that of large nuclear powerplants. The underlying reason is the need to continue technological development, the relatively high unit cost of small and experimental plants, and the probable low volume of large-plant construction.

As to what these estimated total sales will mean to manufacturers of nuclear equipment, the survey report breaks them down into the following mini-

mum and maximum estimates for 1968 (exclusive of installation costs) for the following types of equipment:

Fuel handling equipment: $2 million to $9 million.
Pressure vessels: $17.5 million to $35 million.
Control apparatus: $12.5 million to $24 million.
Heat exchangers or steam generators: $20 million to $39.5 million.
Main pumps: $16.5 million to $31 million.
Main piping: $24 million to $32.5 million.
Main valves: $12.5 million to $23 million.
Tanks and auxiliaries: $19 million to $32 million.
Instrumentation: $9.5 million to $19 million.
Waste handling equipment: $8 million to $16 million.

Foreign activities

The foreign area likely to produce the largest concentrated volume of reactor business of interest to United States suppliers comprises, according to the report, the six Euratom countries—Belgium, France, Germany, Italy, Luxembourg, and the Netherlands. Although Euratom has set a goal of 15,000 megawatts of nuclear power capacity to be installed by 1967, the report points out that if compelled to estimate today, one would have to conclude that the tasks of organization are so great that a businessman's "guesstimate" of the probable range of nuclear construction in the 6 countries by 1967 would have to be between 3,200 megawatts and 5,700 megawatts. The minimum figure is equivalent to 80 percent of the present national programs of the 6 countries, while the maximum figure is the total of the present national programs projected to 1967 plus the equivalent of a recently announced increase in the West German program projected to 1967.

The potential business which may be developed in the United States by direct sales to this area will depend, the report says, both on the choices of particular reactor systems and the increasing proportion of equipment and materials bought from European suppliers. Weighing these considerations, the report estimates that in the next decade approximately 20 to 30 percent of the installed value of United States-type plants built in Europe will prove to be business available to United States designers and producers. This business would involve designs for light-water and heavy-water systems, and relatively specialized components such as control apparatus, fuel cores, and a portion of the pumps, pressure vessels, and heat exchangers which require special fabrication. The majority of nuclear system equipment and all conventional equipment and materials will probably, according to the report, be supplied from European sources.

The report also says that if Euratom achieves a program approximating 40 percent of its 15,000 megawatt goal, prospective United States sales to these countries will probably range from $200 million to $380 million total ordered through 1965.

Fuel cycles

Initial nuclear fuel costs for the large central station power reactors now under construction in the United States are expected by the report to range between 3.5 and 8.5 mills per kilowatt-hour. In the late 1960's, nuclear fuel costs are expected by the report to be in the 3 to 5 mills per kilowatt-hour range based on a plutonium credit of $12 per gram. A large fraction of the reduction in fuel costs is expected to result from decreases in unit fuel fabrication costs and increases in the fraction of fuel burned per cycle. If plutonium credit in the late 1960's is around $30 per gram, as it is at present, fuel costs could range between 1.5 and 3.5 mills per kilowatt-hour, according to the report.

Between now and 1968, the United Kingdom and continental Europe are expected by the report to be the largest consumers of freshly mined uranium for Western power reactors. The total requirement for Western World power reactors is projected to be 4,000 to 5,000 tons in 1958, 4,500 to 8,500 tons in the early 1960's, and 7,000 to 16,000 in the mid-1960's. The report expects comparable United States requirements to be a minimum of 1,000 to 1,500 tons per year for the 1958–68 period, and a maximum of approximately 2,000 tons in 1958, 3,000 tons in the early 1960's, and 5,000 tons in 1965.

The report says that proven reserves of natural uranium in the free world which can be mined and milled at approximately current costs are in excess of 850,000 metric tons of contained uranium metal, and that this figure can probably be doubled in existing producing areas through further development. The

report goes on to say that if mining and milling in the free world should continue through 1956 at 25,000 to 35,000 tons per year, a volume of the order of 200,000 to 300,000 tons will be mined by 1965, leaving at least 500,000 tons in reserve, and possibly more than double this amount.

As for United States proven reserves, the report says these are estimated at 150,000 tons of contained uranium metal. If the rate of extraction is equal to the capacity of United States mills now in operation or now committed for construction, more than half of present proven reserves could be in use by 1965.

The report estimates that cumulative requirements for all free world power reactors will range between 60,000 and 100,000 metric tons of natural uranium between 1958 and 1965. If the Euratom goal of 15,000 electrical megawatts by 1967 is met instead of the smaller program estimated in the report, maximum cumulative requirements may be up to 120,000 tons by 1965. Of the total free world cumulative requirements, the cumulative United States requirements may range, according to the report, between 10,000 and 30,000 tons during the 1958–65 period.

The report cautions: "The bright outlook for relatively short-range availability of uranium should not obscure the necessity for maintaining and ultimately increasing proven reserves. Any large investment in nuclear plants, such as that projected in this study, on the maximum side starting in the mid-1960's, must be based on more than short-range fuel reserves."

The report concludes its treatment of the fuel side of future development by indicating that if United States fuel fabricators provide between 5 percent and 20 percent of the foreign reactor fuel during the 1958–68 period, the combined total annual dollar volume for United States fabricators will be between $20 and $100 million in the early 1960's and $30 million and $140 million in the mid-1960's.

Appendix 4

Excerpt From a Report by the National Planning Association Special Policy Committee

THE PROJECT'S BACKGROUND

In 1953, the National Planning Association felt that the time had come for a broad inquiry into the policy issues arising from the prospective use of nuclear energy for nonmilitary purposes. Resources for the Future, Inc., sharing this view, made a grant of $5,000 to the National Planning Association permitting it to prepare a survey identifying the major topics that might deserve research and policy consideration. This survey, completed in the spring of 1954, indicated the desirability of undertaking studies on a wide range of issues concerning the national, regional, industrial, and international economic aspects of nuclear energy.

The nature of these issues suggested that NPA's characteristic method of operation—through ad hoc committees composed of individuals representing various fields of work—was well suited to the controversial questions that marked much public discussion of atomic energy. Moreover, the NPA felt that sufficient unclassified information was becoming available so that an independent private organization could undertake a study of the public and private policy considerations involved in the productive uses of nuclear energy here and abroad.

On the basis of the preliminary survey, Resources for the Future, Inc., in mid-1954 made a grant of $200,100 to finance the first phases of the present NPA project on the productive uses of nuclear energy. Later, at the end of 1956, this financial support was supplemented by grants totaling $50,000 by the Ford Foundation. These funds have permitted NPA to prepare a substantial number of the studies suggested by the 1954 survey. The National Planning Association is grateful for the encouragement and financial support of these institutions. However, the Ford Foundation and Resources for the Future, Inc., are not to be understood as necessarily approving, by reason of their grants, any of the views expressed in the research studies by the staff or in statements by the special policy committee.

At the outset of the project in the fall of 1954, a special policy committee on the productive uses of nuclear energy was formed in accordance with NPA's established procedures. Composed of leaders in agriculture, business, labor, and the professions, the committee provides assurance of a broad, practical and diversified point of view toward the reports and recommendations of the committee. The

purposes of the committee were to guide the staff in setting up the research program, to act on the question of publishing studies submitted by the research staff, and to make recommendations on major policy issues that were expected to arise in the course of the research program. Dr. Ralph J. Watkins, director of research, Dun and Bradstreet, Inc., New York City, and a member of NPA's business committee on national policy, is chairman of the Special Policy Committee. To Dr. Watkins the NPA is deeply indebted for his generous and conscientious services. The project has gained from the broad experience and knowledge of the committee members who gave unstintingly of their time to this undertaking. (Their names and connections are shown on p. IX.)

The work of the project staff has been carried out under the guidance and general supervision of Dr. Gerhard Colm, who also had prepared the initial survey. The project's director of research, Philip Mullenbach, has prepared the work program authorized by the committee, and guided the studies undertaken by the research staff and the economic consultants. All staff studies have gained by his broad and realistic knowledge of economic issues and his familiarity with nuclear technology.

The research program provided that the several studies on the international aspects would be emphasized initially, while the studies on the domestic aspects would be stressed in the later stages. The case study method primarily has been used to assess the potential need for and effect of nuclear power in 4 underdeveloped and 2 industrial countries. The focus of these, and other project studies, has been on the period of the next 25 years, rather than on the very long run. Several studies on the place of nuclear energy in the United States have also been prepared. These studies have centered on projections of the fuel economy as a whole and the nonelectric power applications of nuclear energy. This was prompted in part by the fact that previously existing economic studies had emphasized the longer term effects of nuclear-generated electricity on especially power-intensive industries.

The economic research for each of the six foreign case studies was undertaken by the project's consultants in the foreign country and with the friendly cooperation and assistance of each government. The findings and views expressed in these case studies are not necessarily those held then or now by these governments. The National Planning Association appreciates the cooperation of experts, in and out of government in Brazil, India, Israel, Italy, Japan, and Pakistan, in furthering the work of the project. The results of these project studies are presented in a series of monographs that are being published by the National Planning Association. These will be accompanied by three studies on selected aspects of nuclear energy in the United States economy. (A list of the project studies and other studies by the research staff published thus far faces the contents page of this report.)

Incidental byproducts of staff research should be noted. These have consisted of contributions to the first International Conference on the Peaceful Uses of Nuclear Energy (Geneva 1955), to the Report of the Joint Committee Panel on the Impact of the Peaceful Uses of Atomic Energy (January 1956), and to the formation of the European Atomic Energy Community—Euratom.

At the conclusion of the factual studies, the special policy committee directed the staff director to prepare for it a summary of its findings accompanied by policy recommendations agreed upon by the committee. For many years policies for electric power, and energy generally, have been matters of controversy. The same is true of nuclear energy. It is significant, therefore, that the special policy committee in this statement has made progress toward broadening the areas of agreement in this field.

The particular policy issues treated in this statement are selective, not comprehensive; they constitute those believed to be immediately in the forefront of public concern. For example, what are the Nation's responsibilities for following through on the President's farsighted atoms-for-peace program? Is the pace and scale of domestic investment in the development and construction of nuclear reactors sufficient to satisfy the requirements of our domestic and foreign policies? How can the United States assure the worldwide introduction of nuclear energy in a manner that provides sufficient safeguards against its inherent dangers? What foreign economic policy for nuclear energy is most likely to encourage durable international cooperation and to avoid the dangers of either extreme economic nationalism or of atomic imperialism? These are a few of the policy questions that leaders in public and private positions, here and abroad, are concerned with and can expect to see examined in this committee statement.

As is NPA's established policy, each member of the special policy committee has had the opportunity of submitting for publication with this report signed comments on the statement as a whole or parts of it. The number and tenor of the footnotes added by members is evidence of the divergence of views on certain nuclear energy policies that still prevails. But more important is the fact that the concise and reasoned expression of these divergent views is certain to contribute to better understanding of the policy issues, and hence to move toward a resolution of them that is in the national interest.

The National Planning Association is indebted to scores of persons, here and in many other countries, who have contributed to the project. Special gratitude is due the members of the special policy committee; to the members of the staff's technical advisory group; to the research staff of the project and the staff consultants. (See listing of research personnel associated with the project in the concluding pages of this report.) We are also grateful for the cooperation and courtesy of the United Nations Secretariat, the International Bank for Reconstruction and Development, the United States Atomic Energy Commission, and the Department of State.

H. CHRISTIAN SONNE,
Chairman, NPA Board of Trustees.

SEPTEMBER 1957.

MEMBERS OF THE NPA SPECIAL POLICY COMMITTEE ON THE PRODUCTIVE USES OF NUCLEAR ENERGY

Ralph J. Watkins (chairman), director of research, Dun & Bradstreet, Inc.
Richard M. Bissell, Jr., Washington, D. C.
J. A. Brownlow, president, Metal Trades Department, AFL–CIO
Gordon Clapp,[1] president, Development & Resources Corp.
Leo Goodman,[2] United Auto Workers, Washington, D. C.
Marion H. Hedges,[1] Washington, D. C.
Peter Henle, assistant director of research, AFL–CIO
Walter J. Levy,[1] New York, N. Y.
Murray Danforth Lincoln, president, Nationwide Mutual Insurance Co.
Edward S. Mason, dean, Graduate School of Public Administration, Harvard University
Stacy May, International Basic Economy Corp.
Arthur Moore, Washington, D. C.
Sumner T. Pike, Lubec, Maine
Adolph W. Schmidt, vice president, T. Mellon & Sons
Henry D. Smith, Princeton University
Lauren K. Soth, editor of the editorial pages, the Des Moines Register and Tribune
Earl P. Stevenson, president, Arthur D. Little, Inc.
Elwood D. Swisher, administrative vice president, Oil, Chemical and Atomic Workers International Union, AFL–CIO
Robert C. Tait, president, Stromberg-Carlson Co., Division of General Dynamics Corp.
J. Carlton Ward, Jr.,[3] president, Vitro Corp. of America.

SUMMARY OF FINDINGS—POLICY SUGGESTIONS FOR THE FUTURE

ONE. THE RECOMMENDATIONS IN BRIEF

Every new invention, it has been said, is abused by human impatience. Yet it is also said that the benefits of invention often are delayed by man's inability to act promptly in surmounting the obstructions to widespread application. In some degree both conditions are reflected in nuclear energy developments today. In seeking the firm middle ground between proceeding too rapidly or too leisurely, we believe that imperative moral, as well as political and economic, considerations are involved.

Morally, we must fulfill the high promises made by the President before the world in 1953 that the Nation is prepared through international cooperation to

[1] See footnotes to the committee report.
[2] Mr. Goodman did not participate in the consideration of this report.
[3] Due to absence from the country, Mr. Ward was unable to participate in the action on this report.

help apply this new technology to the improvement of human welfare everywhere.

Politically, we must maintain full participation in international arrangements in order to assure the safe and widespread introduction of inherently dangerous nuclear reactors and materials.

Economically, we must assist the free nations in meeting their most urgent power needs and, at the same time, advance our own longer time interest in achieving low-cost nuclear power in the United States.

UNDERLYING NATIONAL OBJECTIVES

The policy recommendations that follow are based on fundamental national objectives, namely:

Protecting the national security through international safeguards to the peaceful development of atomic energy.

Maintaining consistency between the objectives of our foreign economic policy and the program of promoting peaceful applications of atomic energy abroad, in part through balanced use of bilateral and multilateral forms of international cooperation.

Strengthening the Nation's reactor development program so as to foster the development of low-cost nuclear power for our longer-term domestic needs.

These objectives call for policies and programs that will help assure the United States a leading role in the prudent development of peaceful nuclear energy in various countries. We are not proposing that the United States strive for leadership for reasons of national prestige, or for reasons of exercising an atomic domination over other countries. What we are concerned with is the possibility of a competitive race for nuclear development which could result in inadequate controls and methods for preventing the misuse of nuclear fuel and for reducing the hazards to life and health all over the globe. We favor a policy which will assure the United States a voice in determining these controls and safety standards. And we are convinced that the best way the United States can assure that it will have that voice is by playing a leading role in the development of nuclear reactors and nuclear fuel.

The United States has established nuclear leadership through the tremendous war effort which resulted in the atomic bomb and through the development since then of a wide variety of atomic weapons and nuclear reactors. Today the United States has a large nuclear industry, a large number of experts, and a large body of theoretical knowledge and practical know-how. The task is to utilize a portion of these intangible and tangible assets for the peacetime development of nuclear power.

In our view, the Nation's future nuclear energy leadership will have to rest primarily on maintaining an advanced knowledge in both the science and technology of the peaceful uses that is consistent with, and does not lag behind, the state of military applications. It will also rest on having something to offer—that is, practical and demonstrable nuclear power reactors needed urgently, for example, by Western Europe and Japan.

The immediately foreseeable capability of the United States to supply full-scale power reactors is limited and may be insufficient to meet the developing requirements of our foreign policy for nuclear energy. The United States has a number of experimental and small pilot reactor projects that are under construction or recently completed. But at present we are still some way from being able to build a large-scale power reactor that promises costs meeting the high conventional power costs in Japan, Italy, or the rest of Western Europe. We conclude that a number of full-scale demonstration reactors constructed with governmental financial assistance need to be built here promptly. This is necessary because:

The reliability, operating performance, and cost prospects for United States designs must be demonstrated soon if they are to help meet the requirements of industrial countries over the next decade and other countries over the longer term.

The prospect for commercial profit from power reactor construction or operation in the United States is too remote to justify a national policy relying exclusively on the current pace of private investment.

The tough technical problems of making nuclear power competitive here probably cannot be met by waiting for the byproduct benefits of foreign development and technology or of military applications.

The United States should be capable of competing with other industrial nations for a substantial part of overseas nuclear power requirements. If we become capable of providing proven reactor equipment and technology to complement the nuclear fuel that has been made available, we shall be in much less danger of failing to fulfill our international responsibilities under the President's atoms-for-peace program. In addition, we shall advance the day when economic nuclear power becomes a reality in the higher fuel cost regions of the United States, such as New England and the upper Midwest.

With our resources in scientific and technical personnel, nuclear fuel and facilities, we need not run the risk of too small and leisurely an approach to our foreign and domestic responsibilities in nuclear energy.

Policy suggestions consistent with these considerations are enumerated below and are elaborated in parts IV and VI.

UNITED STATES NUCLEAR ENERGY PROGRAMS AND POLICIES

Greater private and public reactor development programs

We recommend that:

In order to overcome the substantial technical obstacles to achieving full-scale, economic nuclear power reactors, and to fulfill the commitments of the atoms-for-peace program, the national effort in nuclear energy be enlarged, particularly by substantially greater private and public investment in demonstration reactor construction here.

As part of the enlarged national effort, the development of economic applications of low- and high-temperature process heat from reactors and the applications of nuclear radiations from fission products be expanded by industry and Government. The prospects are encouraging in both fields and have received insufficient recognition compared with nuclear power.

Securing sound cost estimates for nuclear power

We recommend that:

In light of the conflicting cost information currently available on developmental nuclear power projects, the Joint Congressional Committee on Atomic Energy request the United States Atomic Energy Commission to provide periodically, on a comparable basis, unclassified cost reports for industry and the public on experimental and demonstration power reactors that are being, or have been, constructed. These reports might well be furnished annually at the Joint Committee hearings under section 202, on the development, growth, and state of the atomic-energy industry.

Assuring protection of the public and workers in atomic-energy plants

We recommend that:

The Joint Committee on Atomic Energy make a special inquiry into the measures being taken by various agencies to meet the problem of long-term disposal of radioactive wastes. This inquiry should, among other things, include consideration of the action taken on the recommendations of special committees of the National Academy of Sciences in The Biological Effects of Radiation (1956), as these relate to civilian nuclear power.

In view of the fact that most States have not taken steps to meet the need for adequate workmen's compensation: (*a*) the Joint Committee consider nationwide minimum workmen's compensation standards in this field through Federal legislation, and (*b*) the United States Department of Labor carry forward an expanded program of education and guidance for States in the field of workmen's compensation.[1]

---

[1] I believe that the comments on radiation, health, and safety in the text of this report, on pp. 27–29, warrant special attention along with the two recommendations listed here. It is extremely important, as the body of the report indicates, that effective enforcement of adequate health and safety precautions be maintained alertly as a fundamental part of atomic development.

Although there is general agreement in principle on the importance of radiation safeguards, there have been signs in practice that the relatively good safety record accomplished to date by the program of Federal Government regulation may be lulling some persons into unwarranted complacency about radiation hazards and that, particularly in new areas of atomic uses, there is a risk of a cutback or relaxation of the radiation hazard control program enforced thus far.

There should be a continuing awareness that failure to enforce safeguards strictly may lead not only to accidents or incidents of radiation overexposure with serious harmful effects on many human beings, but may lead also to a possible disrupting loss of confidence of workers and the public in the wisdom and safety of atomic uses.—Peter Henle.

The irrelevance of the private versus public power controversy

We recommend that:

The Atomic Energy Commission establish an electric utility industry advisory committee consisting of representatives from all parts of the industry—private and public.

An effort be made by the Joint Committee and the AEC to make clear to the general public that the long-standing private versus public power controversy has no direct bearing on the current issue of accelerating the construction of full-scale demonstration reactors in the United States.[2] [3]

UNITED STATES FOREIGN NUCLEAR ENERGY POLICY

Strengthening international cooperation in peaceful development

We recommend that:

The United States follow up recent ratification of the statute by supporting fully the establishment and operation of the International Atomic Energy Agency. We believe the Agency offers the primary immediate means of assuring security against the diversion of fissionable materials to military use, and of maintaining adequate health and safety standards in the peaceful application of nuclear energy throughout the world.

The United States encourage and provide technical support to the establishment and effective operation of Euratom (European Atomic Energy Community). This new development, it is important to recognize, will strengthen the cohesion of Western Europe, and perhaps also will be a step toward greater cooperation outside Europe.

In the light of the limited resources of most underdeveloped countries, the Department of State and the Atomic Energy Commission strengthen the present program of establishing regional research and training centers for nuclear energy. The urgent need of the underdeveloped countries is to secure the trained scientists and technologists necessary to advance the immediate application of isotopes, and other nonpower uses of nuclear energy and, indirectly, to lay the ground for the emerging, but longer term need for nuclear power.

Recognizing special foreign needs in the United States reactor-development program

We recommend that:

The AEC reactor-development program place additional emphasis on reactor designs and fuel systems that hold special promise for countries confronting problems of foreign exchange availability and limited resources. It would be

---

[2] I agree that the "long-standing private versus public power controversy" need not, on its merits, have a direct bearing on the current issue of accelerating the construction of full-scale demonstration reactors in the United States. The issues are clearly susceptible of separate treatment and should be so treated. But in my opinion, it is not accurate to say that the "private versus public power controversy has no direct bearing," etc.

These two issues have become linked and intertwined in serious political and administrative debate and negotiation. This fact has contributed to delay in reaching agreement on a clear definition of the objectives of the present reactor program, the need for acceleration and revision thereof, and for the reasons proposed in this report.

Admixture of these two issues will delay an objective consideration of the recommendations of this report. The issues can be separated and should be. Existing law relevant to each issue encourages a separation.

A primary agent in mixing these two issues is the AEC itself. It has shown a willingness in recent years to seek, even to create, opportunities to engage as a direct participant in promoting attacks upon public power agencies.

The classic instance in point is the AEC's incredible performance in promoting and underwriting the Dixon-Yates scheme. Its belated repudiation of the Dixon-Yates contract underscored the depth of its ideological reasons for promoting the deal in the first place. The affair hardly qualifies the AEC to persuade the general public it is in fact and practice neutral in the so-called public power controversy. Until the AEC learns how to be, and demonstrates it can be, objective vis-a-vis this issue of important public policy, it will be suspect of its treatment of the relative merits among various conflicting views concerning the scope, methods and means to be pursued in a reactor program; and for reasons set out in this report, the reactor program is a problem of much greater consequence to the United States and to the world than the domestic issue of who owns the electric utility business in the United States.—Gordon R. Clapp.

[3] I must disagree with, and express astonishment at, the postive but naive statement that the "long-standing private versus public power controversy has no direct bearing" on such an important current issue. The manner of accelerating the development of atomic power is in fact a part of the long-standing conflict between partisans of two types of industrial organization, namely, public and private.

The significance of this controversy for atomic energy development was never fully developed by the committee, yet I believe there was no other real issue facing the committee. I state this confidently, having been at all formal sessions of the committee during its 2-year life.—Marion H. Hedges.

well for the United States through its reactor-development program to foster designs that minimize continuing foreign-exchange requirements and that make best use of natural resources available in other countries.

The AEC consider a cooperative program with other countries for the joint design, construction, and operation of smaller developmental reactors in the United States. This program might well be an extension of current training programs for foreign scientists and technicians at the National Laboratories and at industrial installations to provide experience to foreign technicians in the practical problems of design, construction, and operation of reactors going into foreign use.

Facing the economic obstacles to United States business abroad

We recommend that:

The Government encourage and facilitate United States industry in establishing joint nuclear-energy enterprises with foreign manufacturers and constructors, and in establishing branch plants and services in foreign countries. The economic and financial obstacles to the export of American nuclear equipment and technology over the longer term call for new approaches to international business cooperation.

APPENDIX 5

1958: YEAR OF DECISION IN ATOMIC POWER

An address by Elmer L. Lindseth, president, the Cleveland Electric Illuminating Co. before the Cleveland Chamber of Commerce and the Electrical League of Cleveland, Cleveland, Ohio, February 4, 1958

Just a few months ago—on October 4, 1957—the Russians put Sputnik I into orbit around the earth.

That was certainly big news. To a lot of people it was not only big news, but alarming news. In this single event, they saw proof positive that the Russians had licked us hands down at our own game—technology.

Amid the confusion, some calmer voices were heard pointing out that one round doesn't make a prizefight. Then, a short time ago—less than 4 months after the launching of Sputnik I—the United States put into orbit 1958 Alpha, otherwise known as Explorer. We may now hope that this has reassured to some degree a number of the pessimists who were so busy predicting America's eclipse as a world power.

Nevertheless, there are still a lot of skeptics who belittle America's standing in the worldwide technological race for survival.

The simple fact is, however, that although we may at one time or another seem to be temporarily outstripped in some fields, such as satellites—and possibly missiles—we are definitely in the lead in a great many others. On balance, we have an unquestionable overall lead.

One area in which we hold a substantial advantage is the important one of nuclear power.

Since its very inception, America's nuclear power program has had its critics. Even in the presputnik era, some called our atomic power program inadequate. And the Russian satellite launchings gave them further ammunition. Along the way, these critics gained the support of a number of people of good intentions but without full acquaintance with the facts.

The facts about our atomic power program are not widely understood. Because of this, people don't appreciate where the United States stands today, and what the outlook is for the future. Yet it is very important that they should know the facts.

OPERATION OF A REACTOR

As a preliminary, let us review briefly what atomic, or nuclear, power is. What's the nature of a so-called reactor? How does one operate? In what respects is atomic power different from ordinary power?

Many people are surprised to learn that a nuclear powerplant is practically identical in principle with a conventional steam powerplant. The same kind of steam drives the same kind of generators to produce exactly the same kind of electricity. The only thing that is basically different is the fuel—that is, the source of the heat that evaporates water into steam.

In a conventional plant, the heat is produced by burning a fossil fuel, usually coal, oil, or gas, in a furnace or boiler. In a nuclear plant, the heat is produced

by burning nuclear fuel in a reactor. From there on, the heat makes steam, the energy in the steam is converted into mechanical energy, the mechanical energy into electrical energy, the electrical energy into better living.

FUELS FOR NUCLEAR PLANTS

The nuclear plants operating or under construction today all use as fuel one of the isotopes of uranium, uranium 235, which occurs in nature. However, two other possible fuels are known, both man-made—uranium 233 and plutonium 239. These materials are termed fissionable because, under the right conditions and control the nuclei of their atoms may be caused to split or fission in a controlled chain reaction. This is what takes place in a nuclear reactor, and the result is the release of a large amount of usable heat.

Parenthetically, the most abundant form of uranium occuring in nature, the isotope U–238, is itself not fissionable. It may, however, be readily converted—transmuted—into the manmade element plutonium 239, which is fissionable and which is our basic weapons material.

The question is sometimes asked: But what if this controlled reaction gets out of control? Will the reactor explode like a bomb?

The answer is definitely "No." Creating an atomic bomb isn't that simple. A bomb requires a number of precisely regulated components and conditions which are just not present in a nuclear reactor. Any talk about the explosive danger of nuclear powerplants can be traced to an instinctive association of words and ideas. Reactor design principles give any such talk no basis in fact.

The only potential public hazard—and it is extremely remote—is associated with the release of radioactive fission products. These must be properly contained. And you may be very sure that no atomic plant is ever licensed to operate by the Atomic Energy Commission until they are convinced that this problem has been satisfactorily solved.

Every atomic powerplant must get two licenses from the AEC; one to authorize its construction, and a second one, after construction is complete, to permit it to begin operating. This second license is granted only after the plant is certified as presenting no hazard to the public.

So much, then, for our description of a nuclear reactor. Briefly, it is a complex apparatus in which the heat-producing chain reaction takes place under constant control.

The amount of heat given off can be increased or decreased at will, and in some cases is even self-regulating. The heat turns water into steam in another apparatus; and from there on, the operation of the generating plant is exactly the same as that of a coal-burning plant, with all its elaborate and complex components.

FREE POWER A MYTH

We have only to appreciate the nature of atomic power as I have described it to see why it will never be as "free as the air" or "too cheap to meter," despite the claims of some optimists. The only expense eliminated by the atomic reactor is the cost of the conventional fuel—usually coal. And although, believe me, I am by no means indifferent to the cost of coal, it is still only a fraction of the total cost of supplying power. To make matters worse, the atomic fuel substituted for coal today is more expensive than coal. And the same is true of the capital cost of the apparatus to utilize that atomic fuel.

So, as of today, and in the near-term future, when a nuclear reactor is used in place of a coal-burning furnace in any powerplant anywhere in the world—and I emphasize anywhere in the world—the cost of operation is increased instead of decreased. And in most cases the increase is a big one. For example, the cost of producing a kilowatt-hour of electricity at the atomic plant located in Shippingport, Pa., which went into operation recently, is 10 or more times as great as the cost of producing the same kilowatt-hour in a coal-burning plant in that area. Ten times.

The cost of atomic power will, of course, be progressively reduced during the years ahead. That is the prime purpose of our present atomic power program in this country: to make atomic power competitive, dollar for dollar, with conventional power. It will be some years—probably at least 10—before this aim is achieved, because coal is cheaper and more abundant in the United States than in any other industrialized country in the world. Also, we keep constantly

learning how to improve the economy of our coal-serving plants. But eventually, through research, development, and experiment, we'll bring nuclear power down to the same cost level as conventional power.

WHERE UNITED STATES STANDS GLOBALLY

All of this has a definite bearing on our competitive position in what has turned out to be an imaginary global atomic power race: Our objective has been different from the objectives of other nations, where fuel reserves are virtually exhausted. Because this has not been widely understood, the feeling has grown that our achievements have been inferior to the achievements of other nations. This is simply not true.

UNITED STATES HOLDS WORLD LEAD

The United States today holds what Dr. Libby, scientific member of the United States Atomic Energy Commission, has termed "an absolutely commanding position" in nuclear power on the world stage. And under our present program we will maintain that position.

That statement may sound dogmatic, but a simple examination of the evidence justifies it completely. Let's look at what this country has accomplished in the past few years in the nuclear field.

As of the end of 1957, the total number of American reactors for all purposes—electric power, propulsion, testing, research, production, and training—either completed, under construction, or in the planning stage, was 237. There is also a type of modification of a reactor known as a critical assembly using an external neutron source. If the number of these is included, the total figure goes up to 305.

The number of power reactors—that is, reactors for generating electricity or for the propulsion of vessels such as submarines or other naval craft—either built, under construction, or in the planning stages, is 88. In commenting on this figure Adm. Lewis L. Strauss, Chairman of the United States Atomic Energy Commission, said last month, "This total of 88 power reactors represents a program which, to our knowledge, is not approached by any other country, either in performance or planning."

Some of those 88 reactors have already chalked up an impressive record of performance in service. The atomic powerplant of the submarine *Nautilus* has propelled the ship over 100,000 miles and is still going strong. The land-based prototype of the *Nautilus* powerplant, in Idaho, has turned out an amount of power equivalent to over 50 million kilowatt-hours of electricty.

Since the *Nautilus* was launched it has been followed by two more atomic submarines, the *Seawolf* and the *Skate*, and several others are under construction. The keel has been laid for an atomic powered guided missile cruiser, the *Long Beach*. And in fact the Navy has announced its intention of employing atomic power in all combat ships. This country undoubtedly leads the world in the development of a nuclear Navy, and we intend to hold that lead.

Now, let's look at what has been accomplished with the other type of power reactor, the type designed to produce electric power in a land based generating plant. Here, of course, we touch on the interest and responsibility of the electric utility industry. You are entitled to ask what we as an industry have contributed to America's atomic power program, and what we intend to contribute.

CONTRIBUTION OF INDEPENDENT UTILITIES

The participation of America's independent utility companies in atomic power progress began even before passage of the Atomic Energy Act of 1954, notwithstanding that until the act was passed, the Government had prohibited the ownership of fissionable material or reactors by industry and so there was little an independent utility could do about constructing nuclear powerplants. The 1954 act first authorized construction of privately owned nuclear plants. In so doing, it stated: "It is therefore declared to be the policy of the United States that * * * the development, use, and control of atomic energy shall be directed so as to promote world peace, improve the general welfare, increase the standard of living, and strengthen free competition in private enterprise."

In the intervening 3½ years the investor-owned utility industry has worked in close partnership with equipment manufacturers, other segments of industry, and the Atomic Energy Commission. There has been brought into being an all-inclusive program of research, development, and construction of nuclear powerplants.

FIVE PLANTS IN OPERATION

Today there are five atomic powerplants in the United States turning out electricity. Two are at AEC installations. The other three are delivering kilowatts to the customers of investor-owned utility systems, although two of the reactors are Government-owned, and the third owned by an equipment manufacturer.

One of these three located at Shippingport, Pa., is owned by the AEC, although Westinghouse Electric Corp. and Duquesne Light contributed to the cost. It is operated by Duquesne. It is the world's first large-scale atomic plant built exclusively for the production of electric power. It is usually overlooked that Britain's much-publicized Calder Hall plant is primarily for the production of weapons material, and that generation of electricty there is a byproduct.

Two other American atomic plants presently serving customers of investor-owned utilities, are the General Electric-Pacific Gas & Electric plant near Pleasanton, Calif., whose reactor is owned by General Electric Co.; and the AEC-owned sodium graphite reactor at Santa Susana, Calif., on the Southern California Edison Co. system.

These are only the beginning. Five additional large-scale nuclear plants for the production of civilian power are either under construction, or under contract. These are: the Enrico Fermi fast breeder plant of 100,000 kilowatts being built near Monroe, Mich., by the Detroit Edison Co. and a group of utilities known as the Power Reactor Development Corp.; Commonwealth Edison's dual stage boiling water plant of 180,000 kilowatts located southwest of Chicago; Consolidated Edison's pressurized water 275,000-kilowatt plant being built at Indian Point, N. Y.; the Yankee Atomic Electric Co. pressurized water reactor plant of 134,000 kilowatts being built by a group of New England companies at Rowe, Mass.; and the Pathfinder single region boiling water reactor project of 66,000 kilowatts to be built by the Northern States Power Co. and Central Utilities Atomic Power Associates, a group of utility companies on the Northern States system.

In all 5 of these plants the electric utilities concerned own and operate the nuclear reactors as well as the rest of the generating facilities. Two of them will be financed entirely by private industry, and the other 3 are receiving some AEC assistance. When they are all operating, in 1962, they will bring this country's total output of atomic power for civilian use to over 800,000 kilowatts.

Five more electric utility industry projects are in the longer range phases of planning and development.

One, being undertaken by the Carolinas-Virginia Nuclear Power Associates group, is directed toward a 17,000-kilowatt heavy water moderated reactor in South Carolina.

REACTOR FOR FLORIDA

The East Central Nuclear Group has undertaken research and development on a 50,000-kilowatt heavy water moderated, high-temperature, gas-cooled, pressure-tube reactor which will be built on the west coast of Florida by another group, the Florida West Coast Nuclear Power Group.

Pennsylvania Power & Light Co. and Westinghouse Electric Corp., recently joined by Baltimore Gas & Electric Co., are continuing research and development of an aqueous homogeneous slurry reactor, looking toward construction of a 70,000-to-150,000-kilowatt plant by late 1963.

Pacific Gas & Electric Co. has announced that, either alone or in partnership with other California investor-owned utilities, it plans to propose construction of a large-scale nuclear plant to the AEC. The type of reactor under consideration is a large scale, single region boiling water type.

And the New England Electric system contemplates adding a large scale nuclear powerplant to its system by 1964.

RESEARCH AND DEVELOPMENT ARE VITAL

Although this record of plant building and planning is impressive, I should point out that the real strength of America's atomic-power program does not lie in the number of electric kilowatts we can produce. America will stay ahead in atomic power basically through intensive research and development. And in this field, the independent power companies are embarked on an all-out program.

Atomic power is immensely more expensive, and technologically vastly more difficult, than was foreseen even just a few years ago. This applies not only to

the building of plants, but to the carrying out of research and development activities. Therefore, to spread costs and avoid needless duplication of effort, it is the practice of power companies to form into groups of anywhere up to a dozen or even more utilities and undertake nuclear projects cooperatively.

ONE HUNDRED AND TWENTY COMPANIES PARTICIPATING

At the moment, more than 120 companies in the United States are participating in 1 or more of 25 different projects concerned with study research, development, planning, or construction of nuclear plants. These companies serve more than half of the electric power customers in the Nation. Their total expenditures on nuclear projects as presently planned will ultimately run to an estimated $500 million, and the total capacity of the nuclear plants on which they are working is about 1,300,000 kilowatts. Undoubtedly these expenditures will be increased as the program continues to grow.

From such research and development activity will ultimately come the advanced, less costly, more efficient atomic powerplants of the future; and it's the only way we'll get them.

THE FOREIGN SITUATION

Now, what about other countries? What is the situation in Britain? In Russia? In the other nations interested in developing and using atomic power?

These countries are busy, to be sure. But their programs are not being conducted on anything like as broad a scale as this country's program. They are critically short of conventional fuels. Hence, they are more concerned with constructing workable plants today than they are in developing better plants for tomorrow.

The United States alone, among the world's industrialized nations, has a large supply of relatively cheap coal. We are by no means desperate for nuclear power. It will be many years before we can generate it as cheaply as coal-produced power, or will have any need to do so. Thus, our program is focused on bringing down ultimate costs. Because time is on our side, we can put our dollars to best use.

That is my no means true of countries like Britain. There, coal reserves are nearing exhaustion. Coal is costly, and imports of oil from overseas sources are both expensive and uncertain, as was graphically demonstrated during the Suez crisis.

It is only logical, therefore, for the British to concentrate their efforts on getting plants into operation as soon as possible. Time is working against them. Efficiency and cost are minor factors in their situation; their overriding need is for kilowatts. They are not at all happy about spending vast amounts of money on costly reactors which are obsolete when built, but in the circumstances they have little choice.

It is much the same story in the other European countries, including Russia, where the major coal reserves are thousands of miles away from the industrial centers.

Other countries need atomic power now, at almost any cost. We do not. They don't have time for the research and development on a wide range of types that will reduce costs. We do. Therefore, their atomic programs are time oriented. Ours can be dollar oriented. The result, for us, will be vastly more efficient plants in the long run.

RESEARCH AND EXPERIMENTATION

There is in being today in this country a far-reaching program of research and experimentation, plus a wide variety of pilot and large-scale plants to provide us with practical operating experience. On this foundation, which no other country possesses, we will continue to build an atomic technology which will make today's achievements seem feeble by comparison. We have chosen our course wisely, and the future lies in our hands.

This is the background against which the question is raised today: Will the Congress decide to accelerate our atomic-energy program by ordering the construction of a number of large-scale Government-owned plants? Or will they not?

My guess is that they will not order the building of these plants, notwithstanding strong efforts by a militant group to persuade them to do so. But it is by no means certain.

In my belief, the Congress will recognize that this country has a program in being that has given us our commanding lead in world nuclear technology. And, further, that our lead can best be maintained and increased by a continuation

of that program. Any program, of course, needs to be adjusted from time to time to our constantly increasing knowledge and experience. But the emphasis should stay on research and development.

SOME DON'T AGREE

Not everyone in this country will agree with that conclusion. There are loud voices raised to assert that we have fallen behind in their hypothetical kilowatt race, and that only a crash program involving construction of large Government-owned reactors will enable us to catch up.

As to whether we have fallen behind, the facts themselves refute that contention. And if they are not enough, there is the recent statement from the leaders of Euratom, the international organization which is coordinating the nuclear-power programs of six European countries. These European experts asserted, "An impressive amount of research and development done both through the AEC and private industry has provided America with the most complete nuclear foundation in the world."

More large-scale Government-owned reactors in this country would achieve little, and would soak up millions of dollars of taxpayers' money needlessly. Worse, they would divert our energies and resources away from the vital research and development work on which our atomic future depends.

THE THREAT OF SOCIALIZATION

In view of that, it may well be asked who advocates such a program of large Government reactors, and why.

Prominent among the advocates of large Government-owned nuclear power-plants are many of the same people who for years have been urging the Government farther and farther into the electric-utility business. In nuclear power they see a once-in-a-lifetime opportunity to insure the eventual complete socialization of America's electric-power industry.

This process of socializing power has already gone so far as to be a matter of grave concern to thoughtful Americans. Twenty percent of the electric power generating capacity in America today is Government owned, and for years the trend has been toward an increasing proportion.

Those 4 out of 5 Americans who today receive their electric service from the investor-owned segment of the utility industry are discriminated against in favor of the 20-percent minority who do not. The discrimination against the 80 percent extends into the preferential disposal of power generated, the granting of licenses for new generating facilities, and the amount of taxes they pay into the Government Treasury through their electric bills. These taxes are largely avoided by the 20-percent minority.

We are today engaged in a frightfully costly and bitter cold war with Russia over the conflicting philosophies of totalitarian versus democratic government. If we as a nation should allow ourselves to be betrayed into voluntarily abandoning along the way the very principles of free enterprise we are fighting to preserve, we shall indeed have defeated our own objectives by surrendering to the enemy.

WHAT AMERICANS CAN DO

There are a few things that you and I and every American can do to help insure that this country maintains its world lead in nuclear power yet does not become trapped in the pitfalls of Government ownership.

First, we can keep ourselves informed. In the final analysis, the judgment of the American people will determine the course of our nuclear power program. It is absolutely essential that that judgment be an informed one, based on a full knowledge of the facts.

Second, we can learn to recognize the pitfalls along the way—the pitfalls that never fail to appear when Government becomes involved in business enterprises. Socialized power already has a formidable foothold in this country. And it has quite a few adherents who will use any means that comes to hand to strengthen and extend it.

Third, we can be alert to the fallacies inherent in such catch phrases as "cheap Government power" or "public power." So-called public power is preferentially subsidized Government power.

This power is the private domain of a privileged tax-exempt 20-percent segment of the American public.

Fourth, we should consistently oppose any suggestion that this country's supremacy in atomic power cannot be maintained and extended within the framework of our free enterprise system. Our present supremacy was attained within that framework. We can maintain it on the same basis. The effort will be great, and it will require a great deal of assistance, financial and otherwise, from the Government.

But it can be done.

WISDOM OF COURSE PROVEN

The wisdom of our course has already been proven. Continuation of it will insure our continued world leadership in atomic power, while preserving the basic principle of freedom to which our way of life is anchored.

APPENDIX 6

CORRESPONDENCE AND INFORMATION CONCERNING PROPOSED REACTOR PROJECT BY PACIFIC GAS & ELECTRIC CO., AT HUMBOLDT BAY, CALIF.

CONGRESS OF THE UNITED STATES,
JOINT COMMITTEE ON ATOMIC ENERGY,
February 24, 1958.

Mr. N. R. SUTHERLAND,
President and General Manager,
Pacific Gas & Electric Co.,
San Francisco, Calif.

DEAR MR. SUTHERLAND: I was most interested to learn of your company's decision to install and operate by the middle of 1962 a nuclear power reactor of 60,000 electrical kilowatt capacity as was set forth in your telegram of February 18, 1958, to Mr. Lewis L. Strauss, Chairman of the Atomic Energy Commission. Mr. Strauss on February 19, 1958, at a public hearing read your telegram to the Joint Committee on Atomic Energy.

I regret that you declined our committee chairman's invitation to testify at the hearings or submit a statement for the record, and instead sent the telegram to the AEC rather than the committee.

In the telegram, you state that this project will involve no financal assistance to your company and that no assistance from the AEC for research and development is contemplated. I am most interested to learn that the Pacific Gas & Electric Co. intends to finance a substantial reactor facility entirely with its own funds.

As you know, I am chairman of the Subcommittee on Legislation and each year our subcommitee must consider and pass on the authorization of Federal funds which, in effect, subsidize reactor construction by private companies. I would appreciate it if you would inform me of the detail of your proposed venture, because it appears to me that if your company can build a power reactor solely with private capital and without any Federal funds, perhaps others can also do it. I would also like to have these details to be certain that we have not misunderstood your company's intentions which I would assume, would show a determination not to accept Federal assistance in any form in the future for this or other reactor projects.

Sincerely yours,

CHET HOLIFIELD,
Chairman, Subcommittee on Legislation.

PACIFIC GAS & ELECTRIC CO.,
San Francisco, Calif., March 17, 1958.

HON. CHET HOLIFIELD,
Chairman, Subcommittee on Legislation, Joint Committee on Atomic Energy, Congress of the United States, Washington, D. C.

DEAR MR. HOLIFIELD: In response to your letter of February 24, 1958, we are pleased to send you the information which is available at this time concerning the atomic powerplant we intend to build near Eureka, Calif.

Preliminarily, I wish to point out that in the course of our atomic-energy-plant studies it was necessary for us last year to confer many times with

the staff of the Atomic Energy Commission. When we finally determined to install the atomic plant at Eureka, Calif., I thought it desirable to notify the Commission, which I did by telegram dated February 18, copy of which is enclosed. We also informed the Edison Electric Institute and requested it to include our atomic plant in its list of proposed atomic plants to be submitted to the Joint Committee on Atomic Energy. I thought that this would be an appropriate way for the Joint Committee to be advised of the latest plans of the utility industry, including Pacific Gas & Electric Co.

The arrangements which have been made for our proposed atomic plant are, briefly, as follows:

We made an agreement with Bechtel Corp. under which it will design and build a complete atomic plant for us near Eureka on a fixed-price turnkey commercial basis. Bechtel, in turn, made an agreement with the General Electric Co. to furnish the nuclear reactor and steam system as well as the turbine, the generator, and certain associated equipment. These contracts do not involve any financial assistance to us. We do not require or request financial assistance from the AEC for research and development for this plant. The General Electric Co. will fabricate the nuclear fuel for us under a separate contract. The contract price for the plant is $17,200,000, to which we have added interest during construction and overheads, resulting in an estimated total cost of $19,500,000.

The principal factors which, in our opinion, make an atomic plant near Eureka attractive to us are as follows:

1. We will actually need a 50-to-60-megawatt plant addition in Eureka in 1962.

2. Eureka is in a relatively high-cost fuel area. With a conventional steam unit at Eureka, the cost of the additional power provided for our system, including Eureka, with oil at $3 per barrel, would be approximately 8 mills per kilowatt-hour.

3. The atomic plant will be installed on land already owned by us and will be located adjacent to two 50,000-kilowatt conventional steam-electric units. Existing facilities, such as the cooling water system, machine shop, etc., and certain existing personnel, especially supervision, will be utilized for the atomic plant.

4. We expect to obtain 60,000 kilowatts of capacity from the atomic plant, although it is rated at 50,000 kilowatts. Experience gained from our partnership arrangement at Vallecitos indicates that we should be able to achieve this result.

5. It is our intention to operate the atomic plant at a high-capacity factor and to produce 8-mill power with the second load of nuclear fuel and to approach 8 mills with the first load, assuming the sale of plutonium at the presently quoted purchase price of $30 per gram.

Mr. C. C. Whelchel, chief of our mechanical and steam-engineering group, is now preparing a paper which will enlarge upon several of the items in this letter. The paper will be read to the American Power Conference on March 26, 1958. I will send you an advance copy of the paper as soon as it is completed.

Yours very truly,

N. R. SUTHERLAND.

EXCERPTS FROM REMARKS BY C. C. WHELCHEL, PACIFIC GAS & ELECTRIC CO., BEFORE AMERICAN POWER CONFERENCE, SHERMAN HOTEL, CHICAGO, ILL., MARCH 26, 1958

INTRODUCTION

Since 1951 when the Atomic Energy Commission issued a general invitation to industry to conduct studies of dual-purpose reactors, Pacific Gas & Electric Co. has participated in a number of atomic projects. These include the nuclear power group with headquarters here in Chicago; the Dresden plant, with almost $3 million research and development expense by P. G. & E. for that project; the joint project with General Electric Co. in the Vallecitos atomic powerplant; and now as a further step, subject to receiving the usual permits, licenses, and certificates, the installation and operation of a commercial 50,000-kilowatt atomic unit at Humboldt Bay near Eureka, Calif.

VALLECITOS AND HUMBOLDT BAY POWERPLANTS

Tonight, I wish to discuss some aspects of Vallecitos and then tell you something about Humboldt and the thinking which led to a decision to proceed with that unit.

* * * * * * *

HUMBOLDT BAY ATOMIC UNIT NO. 3

The remaining time at my disposal will be devoted to considerations that led to the decision to build a 50,000-kilowatt-guaranteed, 60,000-kilowatt-expected atomic unit for Humboldt Bay, as well as some comments on its design, capital cost, and operating and maintenance expense.

Let me first, briefly discuss the P. G. & E. system and the additional power-supply requirements for the Eureka area in 1962, including the different ways in which they could be provided.

Slide 5. P. G. & E. system map

Pacific Gas & Electric Co. serves an area of 94,000 square miles, extending generally from Bakersfield in the south to Eureka in the north, a distance of about 500 miles. Only the central and northern portion are shown on this map. The peak load was 4,080,000 kilowatts on August 2, 1957, and the largest steam-generating units now under construction are rated 325,000 kilowatts. A total of 72 generating stations—hydro, steam, and atomic—supply the load which centers in the San Francisco Bay area and in the Central Valley of the Sacramento and San Joaquin Rivers. Oil and natural gas are used as fuel in the conventional steam plants.

In the extreme northwestern corner of the system, isolated by mountains from the hydro plants to the east and the principal north and south system transmission lines, is Eureka, the center of California's redwood industry.

The principal facilities serving the Eureka area at the end of 1958 will be:

Two 110-kilovolt transmission lines about 115 miles long from Cottonwood.

The 14,500-kilowatt station A steam plant in Eureka, burning considerable amounts of wood bark and scrap lumber—generally called hog fuel.

The 100,000-kilowatt Humboldt Bay steam plant, burning oil.

The firm capacity of these facilities, with a steam unit or a transmission line out of service, is 145,000 kilowatts, estimated to be adequate to meet growth through 1961. Peak load to date has been 88,000 kilowatts.

Additional facilities will be required for the area in 1962. These could be provided by (1) constructing another 115-mile transmission line at a cost of about $8 million for the line plus another $8 million for steam-generating capacity in large system units located in the San Francisco Bay region, or (2) a conventional 60-megawatt steam unit at Humboldt at a cost of about $11 million, or (3) a 50-to-60-megawatt nuclear unit at Humboldt at a capital cost of about $20 million. The choice, economically, lies between the 60-megawatt conventional steam and the atomic unit at Humboldt; but to determine which we must look at comparative fuel, operating, and maintenance costs.

The cost of the first atomic core, including all materials and fabricating costs except the fuel-use charge, will not exceed $3 million. The fuel elements will be warranted for a life of 10,000 MWD/ton of uranium. Any element failing to reach this exposure level will be replaced at a cost prorated on the basis of its actual useful life. The fuel will be enriched to permit achieving an exposure of 15,000 MWD/ton, and it is expected that such an average exposure will be realized.

The second core is estimated at this time to cost under $2 million and is expected to achieve an exposure of 15,000 MWD/ton.

Experience in the operation and maintenance of Vallecitos has led us to believe that the atomic unit at Humboldt will have substantially the same operating and maintenance expense, exclusive of fuel, as a conventional unit. This represents a substantial reduction in estimated cost compared to earlier studies.

Based on the foregoing capital cost, and expected operating and maintenance expense, we estimate the cost of nuclear power, with the second core and the current credit for plutonium produced by the reactor, to be about 8 mills per kilowatt-hour with the unit operating at 90 percent capacity factor, and having a capability of 60,000 kilowatts.

We believe the 90 percent capacity factor is proper because the nuclear unit should produce for the Eureka area and for the system all the kilowatt-hours of which it is capable, since the atomic-fuel cost is less than half that required

to generate the same kilowatt-hours from conventional-fired steam units; and since their life span will at least equal the Humboldt atomic unit, then Humboldt unit 3 should continue to operate throughout its life at maximum capability.

System-load studies indicate that the nuclear unit operating in the foregoing manner would reduce conventional annual steam generation at Humboldt Bay and system steam plants located in the San Francisco area by approximately 470 million kilowatt-hours annually. The expected saving in system-fuel cost by generating these kilowatt-hours with the atomic unit will offset the annual charges on the additional capital cost of that unit, plus nuclear insurance, thereby producing economically competitive power for this location.

Slide 6. Aerial view of Humboldt and insert map

Turning now from system planning and economic loading of generating units, let us consider the atomic unit from the standpoint of design and integration in an existing powerplant.

The Humboldt Bay plant is located on the mainland shore of Humboldt Bay, 1½ miles opposite the harbor entrance. It is about 4 miles south of Eureka, which has a population of 30,000. Arcata, to the north, with a population of about 4,000, is the only other center with more than 2,500 people within 50 miles of the site. The 50-mile radius population is approximated by the population of Humboldt County (70,000) and Trinity County (5,000). The population density of the 2 counties combined is about 11 people per square mile.

Slide 7. Humboldt Bay powerplant, construction photograph

An important reduction in capital cost is obtained by installing the atomic unit in the existing Humboldt plant where a 50,000-kilowatt conventional outdoor unit is now in service and a second similar unit is under construction and will be operating later this year. Taking advantage of existing station facilities would result in a greater saving for a conventional steam unit, because in the case of the atomic, additional property insurance is required on units 1 and 2. The advantage, however, is still in favor of using this site for the atomic unit.

Slide 8. Humboldt Bay powerplant, plot plan

The relative locations of the units in the station are shown in this slide, with the atomic unit at the right. Perhaps of much greater significance than the initial cost saving, so far as progress in the art is concerned, is the installation of a nuclear unit side by side with conventional units, with the numerous benefits that have and will continue to accrue from the direct comparison between the two types.

Now for a few words on the approach to plant design for this project.

Progress in conventional steam-powerplant design in the utility industry has been made by taking advantage of every opportunity, however small, to reduce power costs. Through the years the yield from this approach has been impressive. Nuclear plants will profit in a similar manner although up to now, except in the design and construction of Vallecitos, the industry's major emphasis has been on scientific improvements from basic research and development programs as differentiated from advances in engineering, construction, and operation. Both of these approaches are important and must continue.

Humboldt atomic unit No. 3 represents a continuation of the determined attack, begun at Vallecitos on unit power costs, through further simplification of equipment, plant design and operating requirements.

Simplification is achieved without comprising safety or reliability. It is made possible by reducing presently high margins in design and operation, as a result of favorable experience at Argonne and Vallecitos, along with incorporating, wherever practicable, advances that have been made in conventional powerplant design. In addition, nuclear technological advancements, which are compatible with low cost at this time, will be included.

Slide 9. Flow diagram

The Humboldt unit represents an enlarged advanced Vallecitos, rather than a scaled-down Dresden. It is a design blending of the expected low fuel cost of Dresden with the low capital cost of Vallecitos.

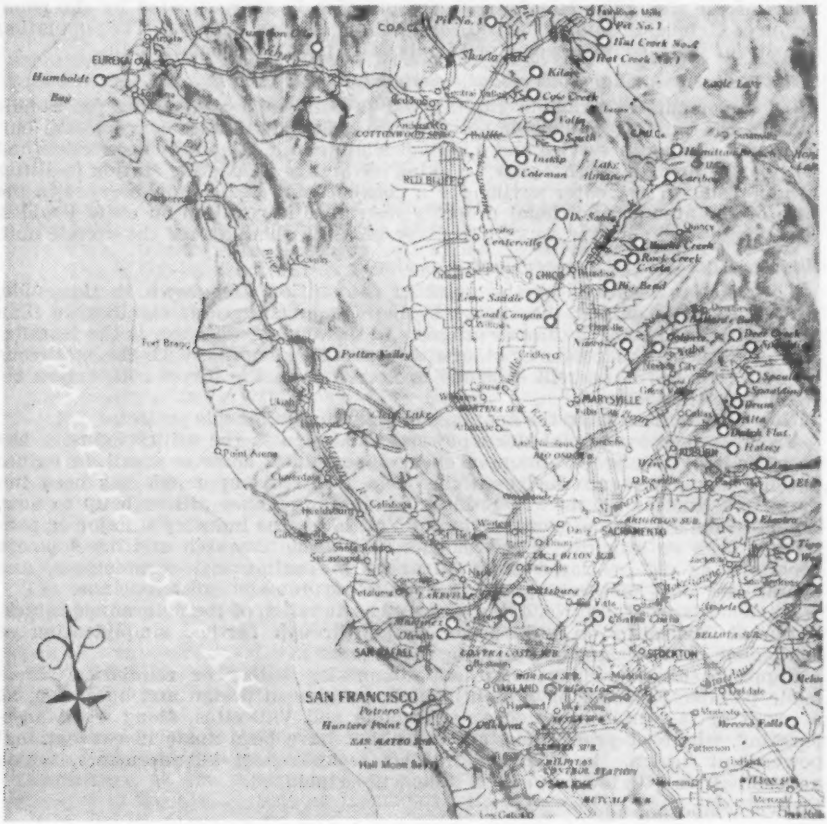
The reactor will employ natural circulation with complete internal steam separation and drying, and will have the largest steam flow using the single cycle principle of any reactor design for generating power. The single cycle approach reduces the complexity of the plant in comparison to the dual cycle by eliminating the secondary-heat exchangers with their required forced circulation pumps. Rod-type, zircaloy clad, oxide-fuel elements will be used. The

3,600 r. p. m. outdoor turbine will have a throttle pressure of 1,000 pounds, saturated, and will be serviced by the existing gantry crane. Two stages of feed-water heating will be provided. These significant characteristics permit simplification, not only in the reactor design, but the plant layout as well.

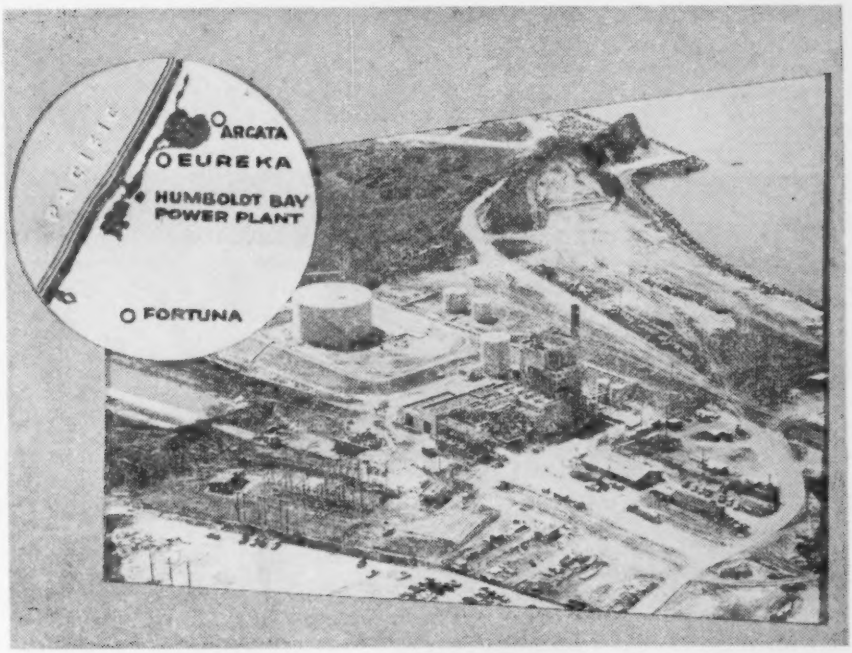
In conclusion, I would like to emphasize that Humboldt came into being as a result of a reappraisal of the state of the art of generating power by atomic energy in the light of today's knowledge and experience and as applied to a medium-size generating unit required for commercial power purposes in 1962. Scientific advancement in this case was not a prime requisite any more than it would be with a conventional unit. The basic requirement was that it should produce economical power for the load growth of the Eureka area as would have been the case had a conventional steam unit been selected.

We expect Humboldt unit No. 3 to produce competitive power, and thereby demonstrate that economical generation of electricity by atomic energy is further along than many had realized.

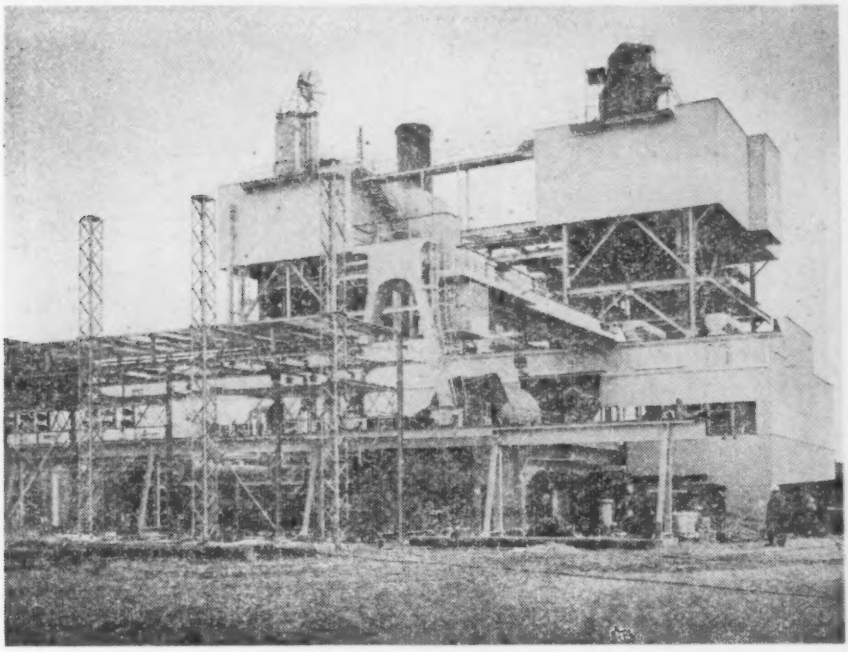
Humboldt is another example of Pacific Gas & Electric Co.'s efforts to advance the art of atomic energy so that its customers and the Nation may have greater assurance of abundant energy sources for the future.



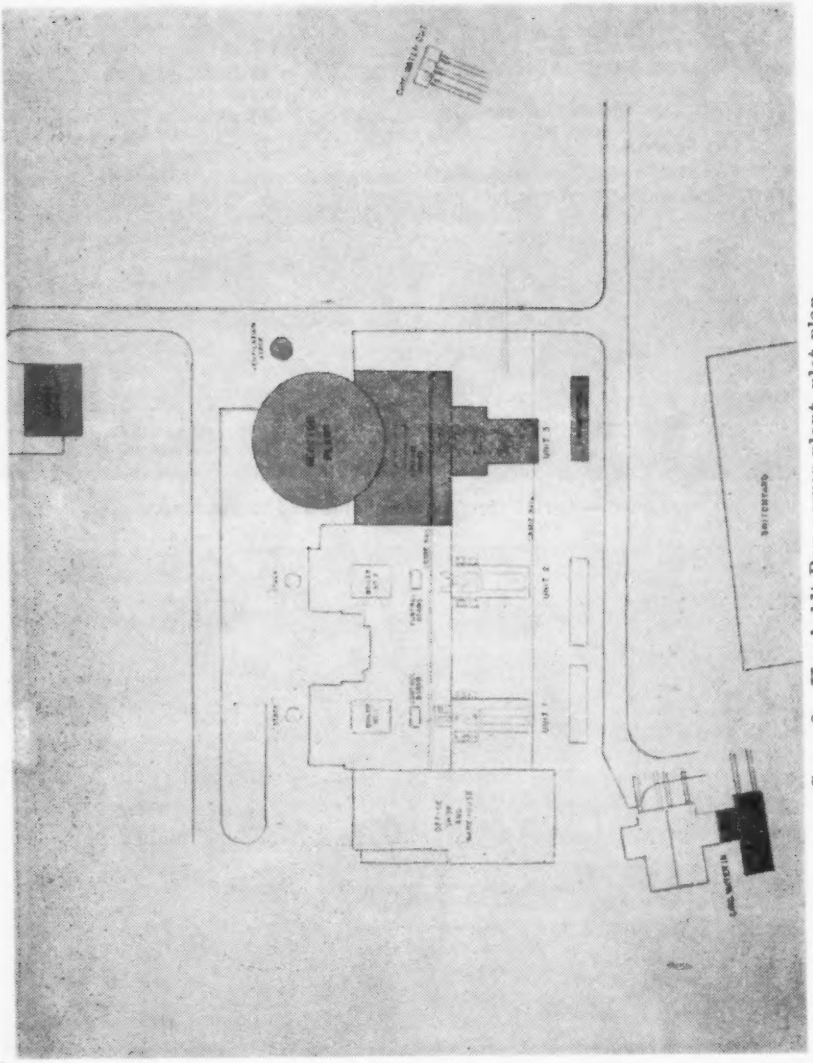
SLIDE 5.—Pacific Gas & Electric map.



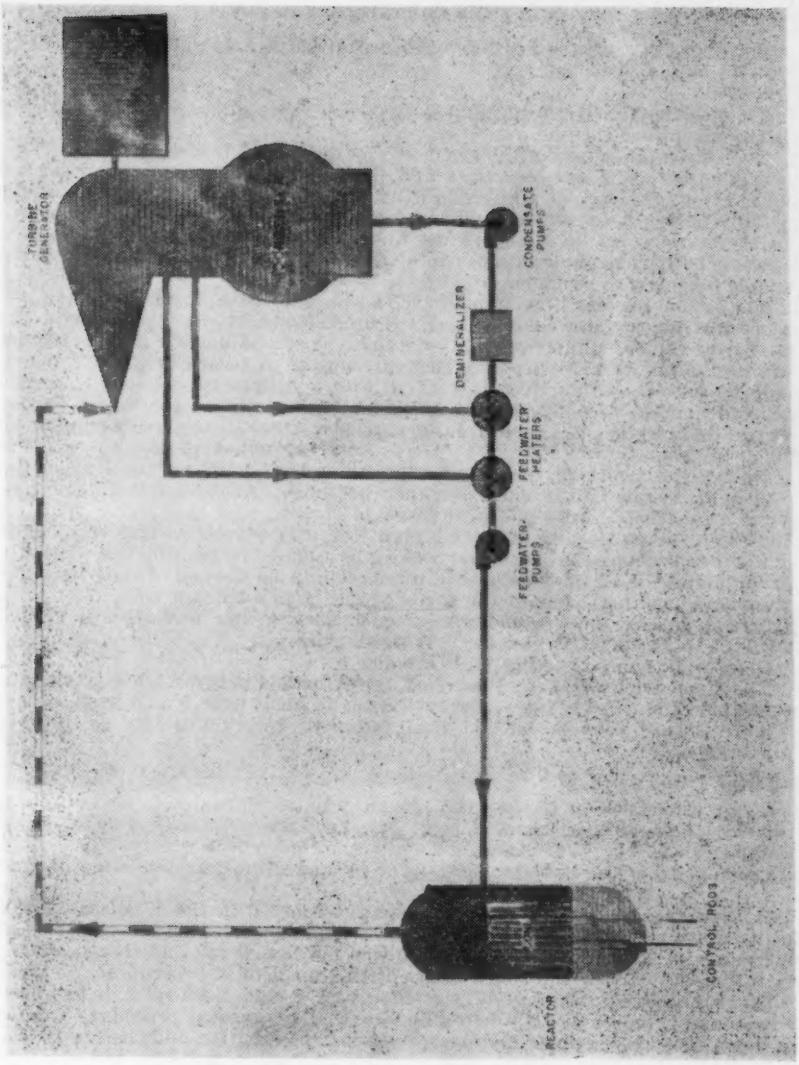
SLIDE 6.—Aerial view of Humboldt and insert map.



SLIDE 7.—Humboldt Bay power plant, construction photograph.



SLIDE 8.—Humboldt Bay power plant, plot plan.



SLIDE 9.—Flow diagram.

APPENDIX 7

(Referred to on p. 125)

EXCERPT FROM BRITISH PUBLICATION ENTITLED "ACCIDENT AT WINDSCALE, NO. 1 PILE, ON OCTOBER 10, 1957"

Annex I

REPORT OF THE COMMITTEE OF INQUIRY

THE CAUSE OF THE ACCIDENT AND THE MEASURES TAKEN TO DEAL WITH IT

Summary

1. The accident occurred during a controlled release of stored Wigner energy from the graphite of the pile.

2. The immediate cause of the accident was the second nuclear heating. This was applied before it was necessary and the nuclear heating was put in at too rapid a rate. The second nuclear heating was applied because it was thought that the Wigner release was dying away and that parts of the graphite structure were therefore going to escape being annealed. The instrumentation of the pile was not sufficient in quantity or in distribution throughout the pile to enable a reliable judgment to be made.

3. The second nuclear heating led to the accident by causing the failure of one or more cartridges whose contents then oxidised slowly, eventually leading to the fire. By far the most likely possibility is that the second nuclear heating caused the failure of one or more uranium fuel cartridges. A second possibility, which cannot be entirely eliminated, is that it was a lithium-magnesium cartridge which failed. The second nuclear heating may have released pockets of Wigner energy at a time when the general level of temperatures throughout the pile was high.

4. During the afternoon of Thursday 10th October, the operating staff of the pile thought they had a bad burst of a fuel cartridge. At 16.30, visual inspection through a plug hole in the pile wall revealed glowing fuel cartridges. Various actions were taken and by about midnight the major decision had been made that if other measures failed, water was to be used to reduce the fire. Shortly after midnight, the Chief Constable of Cumberland was warned of the possibility of an emergency, and men in the factory were warned of an emergency with instructions to stay indoors and wear face masks. Water was actually turned on at 08.55 on Friday 11th October. Water was turned off at 15.10 on Saturday 12th October, by which time the pile was cold.

5. The Committee of Inquiry advised the Atomic Energy Authority that in their opinion the steps taken to deal with the accident once it had been discovered were prompt and efficient and displayed great devotion to duty on the part of all concerned.

The Cause of the Accident

6. The phenomenon of the storage of energy in graphite due to neutron bombardment (the so-called Wigner energy) has been known for some time but when the Windscale pile was designed and built knowledge was scanty. That such energy cauld be released spontaneously or by annealing was not clear at that time.

7. A spontaneous release of Wigner energy occurred in the Windscale No. 1 pile in September, 1952, whilst the pile was shut down. This led to a rise of temperature of the graphite but the rise was not dangerous and there were no harmful effects. As a result of a study of this incident, a procedure was instituted for controlling release of Wigner energy; and eight such releases had been carried out by the end of 1956 in Pile No. 1. The general procedure was to shut down the pile, arrange the appropriate instrumentation and then cause the pile to diverge with no coolant airflow, thus raising the uranium and graphite temperatures and so starting the Wigner release in the graphite. The release is then self-sustaining.

8. It has always been found difficult to release energy in all the graphite of the pile. Consequently, on three previous occasions, it was found necessary to apply a second nuclear heating, some time after the first nuclear heating, when it was seen from the behaviour of the thermocouples in the graphite that the release of Wigner energy was coming to a halt before all the graphite had been annealed.

9. On the present occasion, the pile was shut down at 01.13 on 7th October, and the main blowers switched off in preparation for the Wigner release. All necessary steps were taken to verify that the pile was completely shut down. The thermocouples were checked and those which were unserviceable were replaced.

10. The pile was first made divergent for the Wigner release at 19.25 on 7th October, and the nuclear heating was stopped early the following morning. Some hours later, it appeared to the operators then in charge of the Wigner release operation that the graphite temperatures were dropping rather than rising, and it was therefore decided to apply further nuclear heating.

11. The Committee on Inquiry carefully examined the temperature records on this point. Undoubtedly some of the graphite temperatures were falling and there were some in which no Wigner release was apparent: but a substantial number of graphite thermocouple readings showed steady increases. The Committee would not, therefore endorse the observation that the general tendency was for the graphite temperatures to be dropping rather than rising.

12. However, acting on the observations which he had made, the Physicist in charge decided to boost the release with a second nuclear heating. He had no Pile Operating Manual, with special sections on Wigner release, to help him, nor had he had the benefit of sufficiently detail instructions.

13. The pile diverged for the second nuclear heating at 11.05 on Tuesday, 8th October. The uranium thermocouples showed a temperature increase lasting for about 15 minutes after the pile diverged. The Committee of Inquiry studied the temperature-time records and decided that the maximum rate of rise of temperature for a few minutes was several times greater than that which is permitted in normal operations. However, the maximum uranium temperature *recorded* did not exceed the maximum normal operating temperature.

14. The rapid rate of rise of the uranium temperatures was seen and the control rods were run in to reduce the pile power and thus allow the uranium fuel to cool somewhat. However, in the opinion of the Committee of Inquiry, the damage leading to the accident had probably been done. One or more of the uranium cartridges in the lower front part of the pile had failed.

15. There were two separate and distinct faults of instrumentation affecting the second nuclear heating. First, the uranium thermocouples were situated at the region of highest uranium temperatures during normal operations and were not at the position of maximum uranium temperatures during Wigner release. Because of this, the pile operator was unaware that the uranium fuel in the middle front regions of the pile was probably hotter than was indicated by the readings he was taking, and the rate of rise of temperature was certainly greater than he was observing. A second deficiency of instrumentation was that the pile power meter, whilst correct for normal operations, read low in the situation prevailing. The "feel" of the pile was different and the second nuclear heating was applied too quickly.

16. The picture that the Committee pieced together revealed that, as a result of the second nuclear heating, graphite temperatures gradually rose through Wednesday, 9th October. This led to the oxidation of the uranium which had been exposed by the overheating. The exposed uranium smouldered throughout the course of the day, 9th October, and gradually led to the failure of other cartridges and their combustion, and to the combustion of graphite. By Thursday evening the fire had spread and was affecting about 150 channels in a region of rectangular cross section.

Action Taken

17. During Wednesday, 9th October, the graphite temperatures showed considerable variation but the general tendency was for the temperatures to increase following the second nuclear heating. One graphite temperature in particular continued to rise steadily. By 22.00, the temperature had risen to such a value that the pile Physicist in charge was required, by a written instruction which he had, to have certain operational measures taken. These measures were taken as follows. The chimney base and the inspection holes had been shut at 21.00. The effect was to cause the chimney to draw a little air through the pile and thus cool it, rather than to draw air through the chimney base and the inspection holes. At 22.15, the fan dampers were opened for 15 minutes to give positive air flow through the pile. The dampers were opened again for 10 minutes at 00.01 on the 10th October, for 13 minutes at 02.15 and for 30 minutes at 05.10. These damper openings had a cooling effect on all graphite temperatures except the highest one, where the rise was merely arrested.

18. At 05.40 on the 10th October, at about the end of the fourth damper opening, the pile stack activity meter near the filter at the top of the stack showed a sharp increase. This was noted by the Physicist who was then on duty but no special action was taken because he regarded it as a normal consequence of first movement of air through the pile and up the stack.

19. Between 05.40 and 08.10 the pile stack meter showed falling readings, but at 08.10 the activity began to rise steadily. Soon after noon, high activity was reported on the roof of the Meteorological Station.

20. During the morning of 10th October, the graphite temperature started to rise again, after the temporary halt caused by the damper openings, as explained in paragraph 17. At 12.10 therefore, the dampers were opened for 15 minutes, and at 13.40 were opened for 5 minutes. During the openings, the pile stack meter showed a sharp increase.

21. These effects suggested to the operating staff the existence of one or more burst cartridges. At 13.45, the shut down fans were switched on as a necessary preliminary to an attempt either to use the scanning gear to detect any burst cartridges or, alternatively, to blow the pile cool. At 14.30 the turbo-exhauster was switched on in order to scan for the burst slug. It was then found that the scanning gear was jammed and could not be moved. The Pile Manager stated that at the end of previous Wigner releases the scanning gear could not be moved, presumably because of overheating. On the present occasion it was immovable despite the fact that the Maintenance Section had worked on it the previous day, 9th October, and had moved it.

22. Being unable to operate the scanning gear, recourse was had to another activity-measuring instrument which could take samples of air coming from the pile provided that the turbo-exhausters were running. This meter showed a large reading.

23. At this stage, the Works General Manager was informed by the Pile Manager that there appeared to be a bad burst and he instructed that the affected channel should be identified and discharged as soon as possible.

24. Since the scanning gear could not be moved, it was decided to remove a charge plug in the charge wall in front of the pile, and inspect the channel showing the highest temperatures. Certain steps had to be taken before entry could be effected. An air count had to be taken, to ensure that there were safe working conditions; and the operators themselves had to have a change into protective clothing. Soon after access had been secured to the charge hoist, and the hoist raised to the correct height, the charge plug in the pile wall giving a view of the four uranium channels including the one where the themocouple reading was highest, was removed. The uranium cartridges were seen to be at red heat.

25. The first move was an attempt to discharge the glowing channels but they were found to be wedged owing to the distortion of the cartridges; and prolonged efforts continuing until the following morning were only partially successful in clearing these channels. The next move was to create a fire break by discharging channels adjacent to those which were red hot. This succeeded in containing the area of the fire for some hours but did nothing to reduce the temperature of the affected area.

26. During the night, an attempt was made to bring down the temperatures by use of CO_2 brought over from the Calder Hall site, but this proved ineffective because by then the affected region was too hot.

27. Meanwhile, thought had been given to the possible use of water and by about midnight the decision was reached that if other measures continued to prove ineffective, water should be used. This was the major decision and it was supported by the Director of Production and the Deputy Works General Manager. The Works General Manager, the Director of Production and the Deputy Works General Manager all had in mind that although the fire break appeared to be containing the fire to the 150 affected channels, there was the possibility that further Wigner releases might occur in other regions of the pile, and add to the total heat in the pile.

28. Soon after midnight, the Chief Constable of Cumberland was warned of the possibility of an emergency and men in the factory were warned of an emergency with instructions to stay indoors and wear face masks.

29. By 03.44 the water hoses were ready to be coupled at 15 minutes' notice. At 07.00 it was decided that water should be used but that before it was turned on, all factory labour should be under cover. Some delay was therefore necessary while the shift changed over at 08.00. Water was first turned on at 08.55 but without immediate effect. About an hour later the shut down fans, which had been kept in operation in order to maintain tolerable working conditions

on the charge hoist (where the unloading operations were being attempted), were closed down. This operation, combined with the continued use of water, caused the fire to subside. Pouring of water continued for over 24 hours until, by Saturday afternoon, the pile was cold.

30. The Committee of Inquiry advised the Atomic Energy Authority that in their opinion the steps taken to deal with the accident once it had been discovered were prompt and efficient and displayed great devotion to duty on the part of all concerned.

How the Committee Determined the Cause of the Accident

31. The method by which the Committee of Inquiry reached their conclusion that the second nuclear heating probably caused the failure of one or more uranium fuel cartridges, which then smouldered and gradually caused the fire is highly technical. A number of calculations were made for the Committee, and these, together with the temperature-time records and the known sources of heat, enabled the Committee to determine the maximum temperatures in the pile, and the flow of heat from one part to another. The rate of rise of temperature of the uranium cartridges in the lower front part of the pile, where the trouble started, was found; and the maximum temperature reached by these cartridges, during the second nuclear heating, was estimated.

32. The Committee of Inquiry considered evidence on the behaviour of fuel cartridges in experimental furnaces. They also considered operational data on the failure rate of fuel cartridges in the pile, and the way in which the failure rate depended on the time that a fuel element had been in the pile.

33. The uranium fuel cartridges in the lower front part of the pile, amounting to many hundreds of cartridges in all, had been there for some time. The uranium rods, therefore, had grown somewhat, by radiation damage, and some of the cans were in a state of strain. If the cartridges had been raised slowly in temperature only to the normal maximum operating temperature, by means of a nuclear heating, it is most unlikely that any would have failed. However, these fuel cartridges were raised well above the maximum normal operating temperature; and the maximum rate of rise of temperature was several times the rate of rise in normal operations. Whilst the argument is one of probability rather than certainty, the Committee of Inquiry considered that the most likely cause of the accident was the combined effect of the rapid heating and the high temperature reached by the fuel elements in the lower front part of the pile. In all probability, one or more end caps of the cans of fuel elements were pushed off, and the uranium exposed.

34. The Committee carefully examined all the scientific records taken in order to be sure that it was possible to reconcile their view that uranium cartridges failed during the second nuclear heating, at about 11.15 on 8th October, and smouldered without any of the instruments recording that something untoward had occurred. The Committee are satisfied that the scientific records taken during Tuesday, Wednesday, and Thursday are consistent with their explanation of the accident.

35. The Committee made a detailed study of cartridges containing lithium-magnesium alloy, a number of which were in the pile for the purpose of irradiation. After evaluating the highest temperatures which any of these cartridges could have reached as a result of Wigner releases following the second nuclear heating and after studying the evidence concerning temperatures at which such cartridges have been observed to fail, they came to the conclusion that the cause of the accident could conceivably have been the failure of a lithium-magnesium cartridge but that this was unlikely.

36. The pile also contained a number of other cartridges where various isotopes for industrial and civil research were being formed. The Committee examined each of these in turn and rejected the possibility that any of these cartridges was the cause of the accident.

37. Attention was also given to the possibility that, irrespective of the second nuclear heating, a large local release of Wigner energy occurred in a pocket of graphite which had not been annealed for some time, and that as a result high local temperatures were caused, sufficient to result in the failure of a fuel cartridge, or a lithium-magnesium cartridge, or even the combustion of graphite. The Committee of Inquiry studied the thermocouple records, laboratory data on the failure of cartridges, and general information. The Committee rejected explanations of this type.

38. There are vertical channels in the pile used for experiments connected with the civil reactor programme. At the time of the accident, all of these

channels were empty except one which contained a small magnet under test. There were no experiments either for civil or military purposes being done in the pile during the time of the Wigner release, except for the magnet mentioned in the previous sentence.

APPENDIX 8

CORRESPONDENCE CONCERNING STATUS OF LATIN AMERICAN ATOMIC POWER PROGRAM

APRIL 1, 1958.

Mr. HENRY SARGENT,
President, American & Foreign Power Co., Inc.,
2 Rector Street, New York City, N. Y.

DEAR MR. SARGENT: The Joint Committee is in process of completing its record of its "202" hearings on the development, growth, and state of the atomic energy industry. In that connection it has been noted that there is very little testimony concerning the status of the Latin American atomic power program.

It would be appreciated very much if you would provide a statement for the "202" hearings on the status of your projects in Latin America, together with any comments on the progress and problems encountered and suggestions as to means by which the program can be further encouraged and fostered.

A copy of our original release announcing the "202" hearings and their scope is attached.

Sincerely yours,

JAMES T. RAMEY, *Executive Director.*

AMERICAN & FOREIGN POWER CO., INC.,
New York, N. Y., April 16, 1958.

Mr. JAMES T. RAMEY,
Executive Director, Joint Committee on Atomic Energy,
Congress of the United States, Washington, D. C.

DEAR MR. RAMEY: Mr. Henry B. Sargent, who is in Argentina at the present time, has asked me to reply to your letter of April 1 regarding the status of our atomic power program in Latin America.

I note that you are interested in any comments we might have on the problems encountered in our efforts to carry out this program and that you would like our suggestions as to means by which the program may be further encouraged and fostered.

Some 2½ years ago, the American & Foreign Power Co. announced the initiation of an atomic power program for its associated companies in Latin America, which envisaged the installation of three 10,000-kilowatt atomic powerplants in areas served by these companies. It was felt that the most appropriate locations for these pioneer plants might be in Brazil, Cuba, and Mexico. However, at the time this program was initiated, there were no bilateral agreements in existence between the United States and any country in Latin America which would permi the exportation of atomic reactors and atomic fuels. Furthermore, there was no certainty that insurance could be arranged which would cover third party liabiilty claims which might arise in the future against Foreign Power or its associated company or against the suppliers of the equipment as the result of a possible nuclear accident.

At the present time, although we understand atomic power agreements have been negotiated with Brazil and Cuba, neither has been officially ratified by the Governments of those countries. As to insurance, despite extensive investigations and negotiations carried on by American & Foreign Power Co. and its agents, we have been unable to find any insurance company or group of companies that were willing to provide the insurance coverage that the suppliers of the equipment or our own attorneys felt was necessary and desirable.

During the course of the prolonged official negotiations for the necessary agreements and our own investigations of the possibility of obtaining insurance, it has been necessary to revise our figures on the estimated capital cost of these atomic powerplants and on the power-production cost. At the time our program was originally announced, it was only possible to make very rough estimates and it was believed that their higher costs as compared with conventional thermal plants would be justified by the benefits to be derived by the company and the countries concerned from this pioneer step in the field of nuclear

energy. It was recognized, of course, that there were many practical problems which would have to be solved before this initial atomic power program could be carried out, but it was felt that the answers would be found to the more important questions before the plants were ready for delivery to their destinations.

I regret to say that the more accurate estimates that we now are able to make on the total cost of installation and operation of small atomic power units in Latin America have made it evident to us that our original cost estimates were far too low. Our estimates at the present time are so far beyond the cost of conventional thermal plants as to make the program completely uneconomic in our operating areas, and impossible to justify from the standpoint of our shareholders or from the viewpoint of the customers of our associated electric companies in Latin America whose service rates should reflect the increased cost of producing electricity. Actually, the best figures we have on the cost of installing atomic powerplants in the 10,000- to 12,500-kilowatt range indicate that it will be approximately 4 times that of a conventional thermal plant of the same capacity, while the cost of producing electric power, including fixed charges, at 80 percent load factor, will be more than 2 times as high as for a conventional thermal plant.

In view of the above facts, the conclusion was inevitable that the amount of money required for atomic powerplants, if used presently to enlarge and expand installations of conventional plants, would produce far greater benefits to the areas served. Accordingly, we are suspending our atomic power program until such time as atomic power becomes more nearly competitive and some of the obstacles which have impeded the development of our program have been overcome.

I want to emphasize that this decision of ours represents a suspension of our program and not its complete abandonment. We are still hopeful that developments may occur in the not too distant future which will lower the cost of installing and operating atomic powerplants of the sizes which we consider practical for our Latin American operations; that atomic power agreements will be negotiated with some of the Latin American countries we serve; and that the very difficult insurance problem will be solved.

Any suggestions which we might be able to make as to how an atomic power program might be fostered in Latin America would have to be considered in the light of how important it might be, from the standpoint of United States foreign policy, for our Government to actively promote such a program. We have no specific suggestions as to how the overriding problem of the additional cost of atomic powerplants in the small sizes might be solved other than that some sort of financial assistance might be made available to the manufacturers or to the operators of the plants which would compensate for the additional costs of installation over the cost of conventional plants.

The problem of providing third-party-liability insurance to protect the suppliers of the electric service, if a private company, and to protect the manufacturer of the nuclear equipment, is another matter that will need to be solved, either through the cooperation of insurance companies and underwriters in the United States and abroad or through arrangements made by the governments concerned, possibly with United States Government assistance, to assume the responsibility for providing necessary coverage over the amounts which can be obtained from private companies.

I believe that the problems of higher capital outlay for atomic powerplants and of providing adequate insurance coverage are the principal ones and that if answers were found to these problems there might be no difficulty about obtaining the necessary bilateral agreements.

I hope that the above will be helpful to your committee in considering these matters.

Sincerely yours,

H. W. Balgooyen,
Executive Vice President.

APPENDIX 9

CORRESPONDENCE CONCERNING FOREIGN ATOMIC EQUIPMENT REQUIREMENTS AND PROSPECTS

MARCH 3, 1958.

Mr. K. E. FIELDS,
General Manager, Atomic Energy Commission,
Washington, D. C.

DEAR MR. FIELDS: The Joint Committee would appreciate very much receiving a recent survey or other informational materials which the Commission might develop concerning foreign atomic equipment requirements and prospects.

It is suggested that members of your staff consult with the committee staff, should further clarification of details in this connection be necessary.

Thank you for your assistance in this matter.

Sincerely yours,

JAMES T. RAMEY,
Executive Director.

ATOMIC ENERGY COMMISSION,
Washington, D. C., April 14, 1958.

Mr. JAMES T. RAMEY,
Executive Director, Joint Committee on Atomic Energy,
Congress of the United States.

DEAR MR. RAMEY: This is in reply to your letter of March 3, 1958, concerning information on foreign atomic equipment requirements and prospects. In accordance with your suggestion, your letter has been discussed with Mr. Smith, of your staff, who advised us that your interest relates particularly to sale of nuclear power equipment abroad, and that you desire information based on existing estimates rather than the preparation of a new study.

Consequently, we are basing this reply to your request on the foreign nuclear power capacity growth estimates sent you on April 4, 1958. We think it reasonable to assume, further, that approximately half of this capacity, exclusive of that in the United Kingdom, will consist of plants of United States types. On these assumptions it would appear reasonable to expect that the installed capacity of United States-type nuclear powerplants abroad will range from one-half to 2 million kilowatts by 1964–65, comprising perhaps two-thirds of the total foreign capacity based on enriched uranium fuel from the United States.

It is certain, of course, that initially half or more of the costs of these plants will represent local construction and manufacture of components and this portion will continuously increase. However, it is believed that foreign licenses of United States manufacturers will secure a substantial portion of this business.

While this reasoning leads to a relatively modest estimate of installed United States-type nuclear powerplants abroad through the early 1960's, we are optimistic that competitive nuclear power will emerge abroad by the mid-1960's. If this should occur, orders for large quantities of plant capacity would presumably begin to be placed at about that time and would begin to be reflected in installed capacities in the later 1960's. While it cannot, of course, be said with certainty that competitive nuclear power will begin to emerge by 1965, it seems clear that because of the higher cost of conventional power in Europe, the beginning of this phase in Europe will precede its beginning in the United States. The "target" in the Euratom report of 15,000 megawatts by 1967 is a difficult and probably optimistic one, but we regard the chances that a major portion of this goal will be achieved by this time as very real.

You are aware, of course, of the major uncertainties and limitations of any attempted estimates of the growth of nuclear power, either domestically or abroad, during this development phase. Regardless of their source, it is probably wise not to accept any such estimates as authoritative predictions but at most to utilize them as general guides for planning purposes, subject to continual revision.

We have recently contacted the major reactor manufacturers with the view of determining the actual scope of their present foreign sales activities. The appended table represents a summary of this information.

In addition to nuclear-power equipment, significant sales of other nuclear equipment, such as research reactors and radiation instruments, are anticipated. The program of financial grants for research reactors abroad, announced by

President Eisenhower in his Penn State address of June 11, 1955, is giving substantial stimulus to the sale of research reactors abroad. Seven grants were approved prior to the present fiscal year and it is hoped that 8 to 10 additional grants will be approved prior to June 30 and 10 more during fiscal year 1959. Thereafter, the research reactor grant program will probably taper off. In addition, sales are now being made, and will continue, of research reactors for which grants will not be requested. In general, however, the ability of other nations to manufacture components and provide services locally, will gradually reduce United States participation in the research reactor field in the next decade.

Sincerely yours,

R. W. COOK,
Deputy General Manager.

Status of contracts and exploratory discussions for sale of United States reactors to foreign countries[1]

	Total	Contracts or agreements signed	Contracts under negotiation	Bids submitted in response to invitations	Other exploratory situations
By location:					
Europe	25	2	1	12	10
Asia	8		2	2	4
Western Hemisphere	9		3		6
Other	3			1	2
Total	45				
By completion date:					
1958-60	4	1	1	2	
1961-62	26	1	4	11	10
1963	4			1	3
Not given	11		1	1	9
Total	45				
By capacity:					
Up to 50 megawatts electrical	24	1	5	6	12
50 to 100 megawatts electrical	2			1	1
100 megawatts electrical	19	1	1	8	9
Total	45				

[1] These statistics reflect separate and distinct projects and are not duplicative.

APPENDIX 10. LETTER DATED APRIL 23, 1958 FROM SENATOR CLINTON P. ANDERSON, VICE CHAIRMAN OF THE JOINT COMMITTEE, TO CHAIRMAN DURHAM COMMENTING ON STATEMENTS SUBMITTED BY AEC

APRIL 23, 1958.

HON. CARL T. DURHAM,
Chairman, Joint Committee on Atomic Energy,
Washington, D. C.

DEAR MR. CHAIRMAN: This is in response to your invitation for comments on the statements submitted by the AEC on the atomic power program in lieu of further testimony and cross-examination during the 202 hearings. As you know, it was agreeable with me to postpone the AEC atomic power presentation until the end of the hearings but I was somewhat disappointed that it was determined to postpone their presentation entirely until the authorization hearings. However there may be some benefit in having an opportunity to comment on the AEC statements in lieu of cross-examination.

The following brief comments are therefore submitted for whatever they may be worth. I would expect to continue this line of inquiry during the authorization hearings.

1. The AEC explanation concerning the telegrams received last year seems to me to gloss over several facts.[1] With respect to the American Gas & Electric Co. telegram, it should be noted that before final submission by the AEC their proposal was considerably modified as was the Florida proposal. The answer on

[1] See p. 9 of this publication.

the Pacific Power & Light Co. in the Northwest should have simply stated that they have apparently done nothing since the date of the telegram last year. The P. G. & E. arrangement of this year is also considerably different from that envisaged last year. In connection with this year's telegram it should be noted from the subsequent explanation by the company that they are depending on a $30 plutonium buy-back price to subsidize their operations. From the Joint Committee hearings to date there does not appear to be any likelihood that such a price will be maintained.

II. The Commission's statement as to reactors built, building, planned and dreamed about,[2] sounds about the same as the power company advertisement of a couple of years ago to which Senator Gore and I took exception. They even refer to my favorite defunct reactor experiment which had the charming name of Clementine. The AEC footnotes, however, are frank enough to admit several errors in the compilation of the numbers of reactors. Thus, for example, it is pointed out that the three Latin American reactors of the American & Foreign Power Co. have been indefinitely deferred. Unfortunately no matter how this list is prepared it shows that between now and 1961 we will have only one full-scale prototype power reactor on the line—the Shippingport reactor constructed by the Government. I may have more to say about this list of reactors in subsequent hearings.

III. The Commission's comments[3] with respect to the findings of reactor experts and industrialists on the status of the atomic power program was admittedly not responsive to the request of the chairman of the Joint Committee. I only hope that the program which the Commission comes up with will be as responsive as the letter indicates the Commission believes it will be. This, too, should be gone into in the authorization hearings.

Very truly yours,

CLINTON P. ANDERSON,
Vice Chairman.

---

[2] See pp. 36–42 of this publication.
[3] See pp. 579–581 of this publication.

INDEX

(A more detailed subject matter index is being prepared and will be issued at a later date.)

Page

Controlled thermonuclear development 10, 346, 434
  Access to classified information 13, 28, 146, 153, 348
Information policy 53
  Access permit program 53, 369
  Exchange of information with Allies 20, 22, 25
  Classification and declassification 15, 21, 34, 42, 48, 53, 293
  Dissemination of information 43, 54, 153, 262, 369
International atomic program 4, 76, 101
  Assistance to United States industry 127, 152, 184, 194
  Bilateral agreements 79, 88
  Foreign indemnity 78, 357
  Foreign nuclear equipment requirements and prospects 5, 80, 83, 161, 174, 194, 384, 436, 510, 601, 622
  International Atomic Energy Agency 77
Latin American program 620
Licensing, inspection, and regulation 84, 95, 97, 110, 299, 441, 515, 558
  British inspection system 99
Manpower and training 33, 44, 52, 54, 56, 107, 138, 370
Patents 66, 69, 193, 421, 446, 544, 559
Pricing policy and charges 53, 61, 67, 127, 176, 432
Radioisotopes 51
Raw materials (*see also* separate Joint Committee print entitled "Problems of the Uranium Mining and Milling Industry") 104, 509, 551
Reactor development 6, 36, 585
  Accelerated reactor program 127, 163, 181, 206, 225, 310, 411, 431, 596
  AEC comments 569, 571, 577, 580
  Industry participation 181, 389, 429, 460, 522, 525, 526, 528, 536, 538
  Military reactors 219, 258
  Municipalities participation 540
  Natural uranium gas-cooled reactor 165, 175, 353, 397
  Nuclear power costs 131, 136, 404
  Nuclear reactors for space vehicles and rockets 32, 150
  Power demonstration reactor program 48, 152, 155, 277, 325, 343, 372, 391, 450, 460, 571
  Seminars of Joint Committee 583, 584
Safety and public health. (*See* Licensing, inspection, and regulation.)
State regulation of atomic energy 90
  Radiation standards and inspection 95
  Summary of State legislation and regulations 92
Supplying of nuclear materials 65
  Processing and irradiation service 66, 260, 399, 503
Waste disposal 92
Windscale accident report 616